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THE ST. MARY'S FALLS CANAL.

St. Mary's Falls Canal is situated at the village of Sault Ste. Marie, Michigan, and affords a navigable channel by means of which the principal rapids of St. Mary's River are passed. The river is the outlet of Lake Superior, and it empties into Lake Huron. The canal is 15 miles from Point Iroquois, the foot of Lake Superior, and by the present route of navigation is 60 miles from Point Detour, Lake Huron. The rapids known as Sault de Ste. Marie are a little more than half a mile in length, and have a fall of from 16½ to 18½ feet, depending upon the stages of water in Lakes Superior and Huron, the mean fall being 18 feet. From Lake Superior to "the Sault," the fall is only one-tenth of a foot; thence to Lake Huron it is about 2 feet, distributed through a distance of about 20 miles.

Hence "the Sault" is the only obstruction to such navigation as the depth will admit of between the two lakes.

Prior to 1845, the fur trade constituted almost the entire commerce of Lake Superior. At that time the development of copper and iron mines was commenced, and "the Sault" was found to be a serious obstacle in the way of the successful prosecution of these enterprises. The products of the mines, the appliances for working them, and the supplies for the laborers had all to be unloaded from vessels at the foot of "the Sault," carried overland to the head, and there reshipped to their destination. At first the portage was made with horses and wagons. Subsequently a tramway was built and operated with horses, in this way greatly increasing the facilities and ameliorating the conditions.

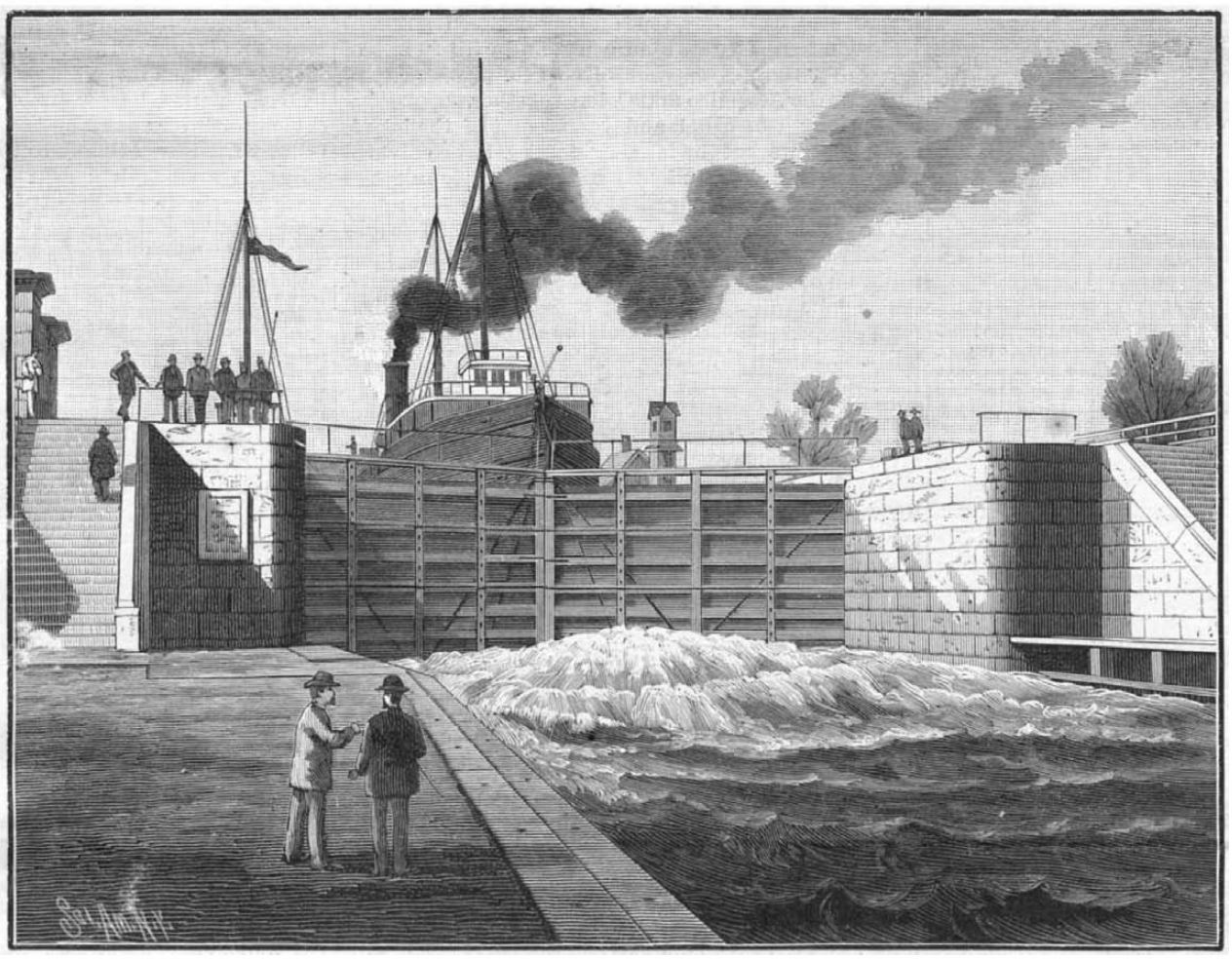

Fig. 1.—ST. MARY'S FALLS CANAL.—END VIEW OF LOCK WITH GATES CLOSED.

As time passed on, steamers and sail vessels were transported upon ways from below to the head of the rapids, relaunched, and used for carrying the freights which were rapidly increasing and rendering the detention and difficulties of the portage at "the Sault" quite too great to be borne.

Application was made to Congress for relief, resulting in the act of Aug. 26, 1852, by which 750,000 acres of land were granted to the State of Michigan, "for the construction of a ship canal around the Falls of St. Mary's in said State."

It must not be supposed that earlier efforts had not been made toward the construction of a canal at this point.

(*Continued on page* 386.)

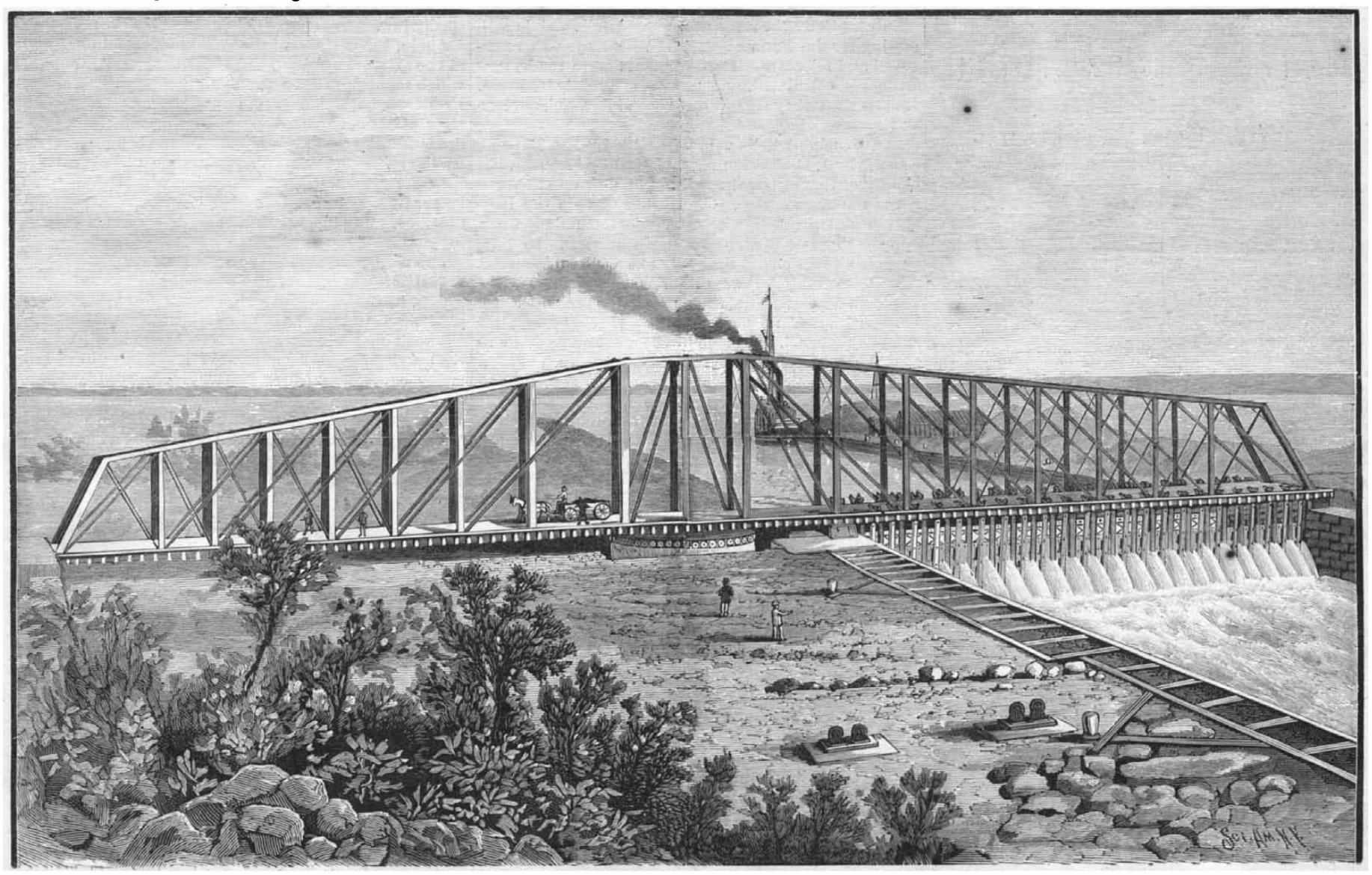

Fig. 2.—ST. MARY'S FALLS CANAL.—VIEW OF THE MOVABLE DAM, CLOSED.

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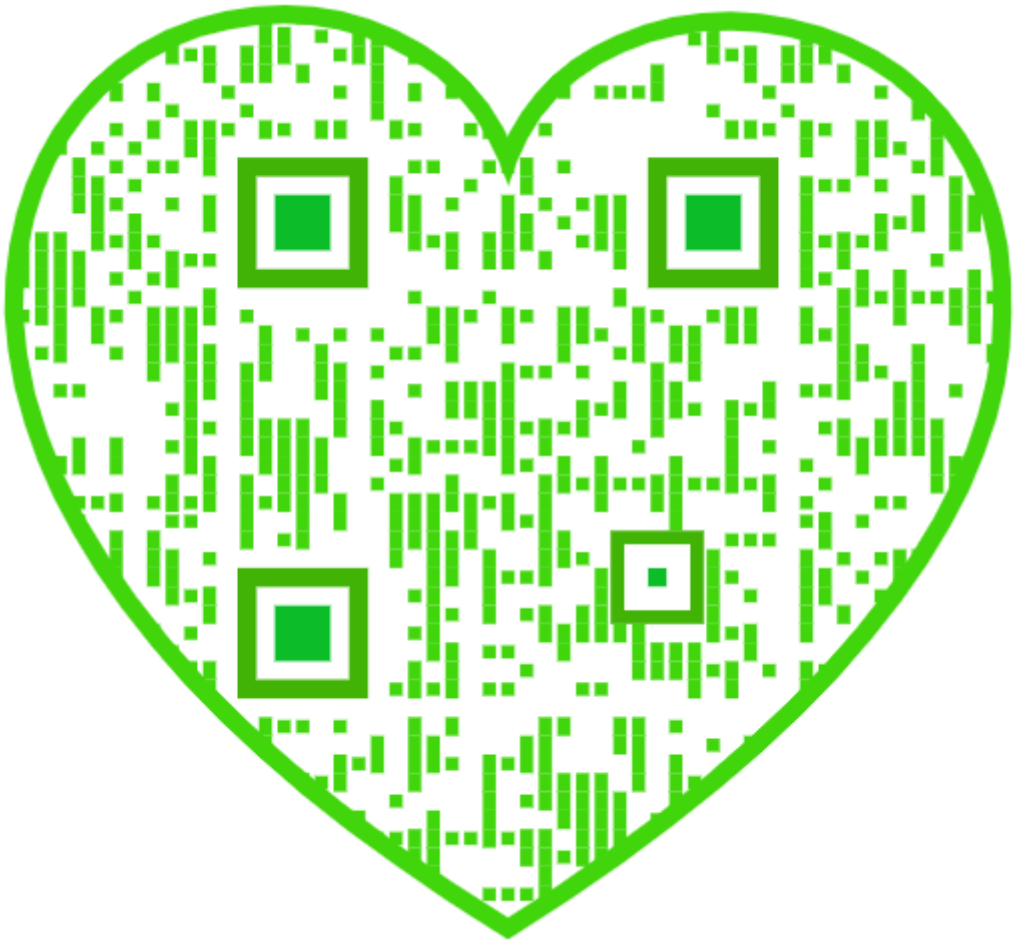

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REVIVAL OF THE NICARAGUA CANAL PROJECT.

An official report has been submitted recently to the Navy Department by Civil Engineer A. G. Menocal, U.S.N., of the relocation of the Nicaragua Canal made by the government expedition of last winter.

The route now given the preference extends from the harbor of San Juan del Norte, or Graytown, on the Caribbean Sea, to the port of Brito, on the Pacific, a total distance of 169·8 miles, of which 40·3 miles are canal proper and 129·5 miles open navigation through Lake Nicaragua, the river San Juan, and the basin of the river San Francisco.

The summit level is 144·8 miles long, and is elevated 110 feet above the mean level of the sea. It is supplied from Lake Nicaragua. Three locks are projected east of this level, and four locks west. The first lock east of the lake is intended to have a drop of 53 feet, and a rolling or tumbling gate of original design has been invented by Civil Engineer Peary. The locks are to be magnificent structures, 650 feet long between gates, 65 feet wide between gate abutments, and with 29 feet of water over the sills, capable of containing the City of Rome or the Acapulco and Colon together.

The length of canal and basins east of the lake is 22·44 miles; west of the lake, 16·54 miles, but so divided that vessels can conveniently pass each other except at short intervals, the longest of which is only 3·67 miles.

The yearly capacity is estimated at 20,000,000 tons (against 6,000,000 on the Suez Canal). The time of passage from ocean to ocean is to be 30 hours, perhaps less.

The lake will require to be excavated and dredged for a distance of 8½ miles, and the San Juan River 24 miles. The San Francisco requires but slight excavation.

The soil to be excavated for the canal is mostly sand, gravel, and rock, not much clay having been observed, giving a desirable average.

The climate is styled salubrious, inasmuch as no officer was sick for a day during the four months of the survey.

By the new plan, the necessity of large harbors to accommodate shipping will be obviated, by reason of the change of location of the tidal lock at Brito from the inner end of the harbor to a point 1·4 miles inland, virtually extending the harbor that distance. At the Graytown end the tidal lock is 11·6 miles inland.

The water supply is estimated to be ten times as much as will be required for lockage.

As compared with former route, the length of the line from sea to sea has been reduced 11·46 miles, the length of the canal proper reduced 21·44 miles, and the number of locks from 21, as proposed by the United States Surveying Expedition of 1872–73, and 11 as proposed by Mr. Menocal in 1880, to 7.

The work, it is asserted, can be completed in six years; and the cost, on a new and reduced basis of estimate of prices, as compared with that of the location of 1872–73, is given as $64,043,699.

Substantially the same process was followed in estimating for the Panama Canal. The route was resurveyed and relocated. Improvements were made, new estimates calculated, and the costs greatly reduced. Results show they should have been increased, not lessened.

In a trenchant little volume entitled "The Panama Canal," by J. C. Rodrigues, just issued by Scribner, the history of that enterprise is brought down to September of the present year. The author was on the Isthmus in 1880 with De Lesseps's technical commission, and appears to be quite at home in the subject. In 1879, when it was estimated that only 46,000,000 cubic meters must be excavated, it was estimated that the cost would be $85,000,000, and the time required four years. De Lesseps himself now admits that 125,000,000 meters must be removed. Others put the amount as high as 150,000,000. Up to June, 1885, only 13,000,000 had been removed, of which not over three-quarters of a million had been taken during any one month. The most rapid progress possible, then, with unlimited capital, would seem to demand at least twelve years for the completion of the enterprise.

Estimates indeed range from this up to fifty years, and it is by no means certain that the obstacles are not insuperable. The problem of so directing and restraining the Chagres River that it shall not in an hour demolish and sweep away the labor of years does not appear to be soluble on any *a priori* considerations, but only satisfactorily demonstrated by its actual accomplishment. Again, who can predict with certainty the successful removal of the Culebra Mountain, and can give reasonable guarantee that the ditch, if ever dug through clay and quicksand, can be maintained secure from inroads of detritus borne by the torrential currents so often following the wake of tropical storms?

Assuming for argument's sake, however, that the work may possibly some time be completed, Rodrigues figures out the cost as not less than $540,000,000, and the annual amount of expenditures over receipts as over $16,000,000.

The present condition of the Panama Canal offers very little inducement for the construction of a second and rival canal at Nicaragua. For the present, so far as our government is concerned, much the wiser course will be to give what little encouragement is needed—and only a little is asked—to the construction of Capt. Eads' ship railway over the Isthmus of Tehuantepec. The Mexican government has granted the rights of way and made other valuable concessions of lands and moneys. The project is indorsed by eminent engineers, is approved by nearly all representative men who have given the subject consideration. Public opinion is setting strongly in its favor all over the country.

In considering the merits of a Nicaragua Canal and a Tehuantepec Ship Railway, we should remember that estimates of railway construction, owing to vast experience, may be made with precision, while those of ship canals, for lack of experience, are notoriously unreliable and misleading. This fact has evidently become apparent to the practical mind of the President, for in that part of his message to Congress in which he alludes to the matter, he expresses an unmistakable preference for the Eads ship railway. He says: "The Tehuantepec route is declared by engineers of the highest repute and by competent scientists to afford an entirely practicable transit for vessels and cargoes by means of a ship railway from the Atlantic to the Pacific. The obvious advantages of such a route, if feasible, over others more remote from the axial lines of traffic between Europe and the Pacific, and particularly between the valley of the Mississippi and the western coast of North and South America, are deserving of consideration."

In these few words the President hits upon the two principal features of the ship railway project, and factors which any scheme of trans-isthmian transit should possess to win popular favor.

In these practical days, it is not enough that a scheme should be possible, it must be practicable.

The returns must not only be commensurate with the cost of construction and maintenance, but it must be possible to foresee with something like accuracy the sum total of gross expenditure. There is always a tendency among projectors to get the State so involved in their schemes as to be unable to retire; for once in deep enough, retreat can only be made by a sacrifice of what has already been accomplished.

It is not meant by this to cast any discredit upon those urging the Nicaragua Canal route. No doubt they are entirely sincere in their belief that their estimate is a true one, and there is nothing to show a sinister design of misleading the government. But it cannot be overlooked that a recent government commission, made up of capable engineers, estimated the cost of a canal at Nicaragua at $100,000,000, or $15,000,000 more than the original estimate of the Panama Canal, and that the report of Major McFarland, made some years ago and suppressed, estimated this cost at $140,000,000, with labor at one dollar a day—a rate which is shown by the prices now ruling at Panama to be absurdly low.

Again, the position of the Tehuantepec Ship Railway at the extreme northern end of the narrow strip of land which separates North from South America is, as the President implies, a very important advantage. To cross at Panama or Nicaragua, a ship must sail hundreds of miles down the Isthmus, and then back again on the other side to regain her course; the route from New York to San Francisco being about 1,200 miles longer by way of Panama than *via* Tehuantepec, and about 600 miles longer *via* Nicaragua than *via* Tehuantepec.

The ship railway scheme appears to present many valuable features. It can be completed and put in operation, its projectors say, within four years. Would it not be well to try it? If, after all, we must ultimately fall back on the canal, we can still have that alternative; and meanwhile, unless the Panama scheme collapses, experience gained in the progress of that work may throw much light on the working details of the Nicaragua route, and if, after all, De Lesseps should surprise all the critics by snatching victory out of the jaws of defeat, why, then, we should have an interoceanic canal, and there certainly is not business enough for two; while, on the other hand, the Tehuantepec Ship Railway would be an extremely useful and convenient one, canal or no canal.

A Valuable Cotton Hybrid.

Dispatches from the South state that ex-Mayor Schorten, of Baton Rouge, Miss., has produced a hybridized cotton plant, about 14 feet in height, and capable of yielding four bales to the acre, should its successful culture be accomplished. It is matured by removing the stamens of the cotton blossom early in the morning before it opens, and by hybridizing the pistils of the cotton by the pollen of an ocra blossom. The hybridized blossom is then protected by cloths to prevent insects from doing it any harm. As soon as the boll is formed, the cloths are removed. The two prolific stalks raised this year had produced a sufficient amount of seed to plant an acre. The lint of the hybrid is reported to be long and silky. Should the seeds prove fertile, the new variety will be of immense importance.

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THE POWER REQUIRED TO OPERATE THE SHIP RAILWAY.

We publish elsewhere a letter from Mr. C. K. Needham, civil engineer, expressing a doubt as to the possibility of locomotives starting so heavy a mass as a ship on a single car.

He says: "When a locomotive begins to pull a heavy train, it is necessary that the connections between the cars should have some slack or spring. Otherwise the most powerful locomotive could not overcome the quiescent inertia of the train."

This is an error; he doubtless meant to say that a locomotive which is sufficiently powerful to keep a train in motion after it is started is not always powerful enough to start the entire train, unless some slack exist in the couplings between the cars. This is true. The problem is really a very simple one; numberless experiments have been made to determine the amount of frictional resistance to be overcome in starting trains from a state of rest, and the amount of this resistance when the same train is in motion. The friction in each case is of a double character—the rolling friction, created between the periphery of the wheels and the rails, and the sliding friction, created between the journals and the boxes in which they revolve. This latter is generally called axle friction. Rolling friction results from the fact that all materials used by engineers are more or less elastic. The hardest steel is no exception to this rule. When a steel ball is dropped from the height of a few feet upon a flat steel plate, it rebounds, and is thrown upward to about half the height from which it fell; this could not occur if the two surfaces of steel were not elastic. The plate is indented, temporarily, by the momentum of the sphere, and the shape of the sphere is momentarily distorted by the resistance of the plate. The rebound is the result of the instantaneous recovery of their respective forms.

When a wheel is at rest upon a rail, the rail is depressed beneath it, and the circular form of the wheel is also changed in proportion to the amount of the weight which presses the two surfaces together, the change of the form of each being analogous to that which would occur if both were made of India rubber. The force necessary to roll the wheel, when the rail is perfectly level, is that which is required to depress the rail as the wheel advances, and to cause the wheel to alter its form as it rolls forward on the rail; this resistance is known as rolling friction, and it will be reduced in proportion to the hardness of the surfaces in contact. The force necessary to start a wheel from a state of rest will be greater than that required to keep it rolling after it has started, because the element of time affects the problem. If the wheel is rolled rapidly over the rail, the two surfaces will not have the time necessary to accomplish the full alteration of their forms before the pressure has ceased at the point of contact. Hence the rolling friction will be decreased if the velocity be increased. The phenomena of sliding friction are so well known that it is not necessary to allude to them.

The results of the many experiments that have been made to test the amount of axle and rolling friction in railroad trains when at rest and in motion vary very much, because of the difference in the lubricants used, the degree of accuracy with which the wheels and axles are turned, the fit of the boxes, the size of the journals, the various weights carried on them, and the accuracy and hardness of the rails and wheels. The greatest resistance to starting the train, recorded by these experiments, is, we believe, about twenty pounds horizontal strain to each ton of weight of the cars. When in motion, this resistance falls to about five pounds per ton. If we take a train of ten cars, assuming each to weigh forty tons, the resistance to the starting of each car will be equal to eight hundred pounds, and for the ten cars eight thousand pounds. The resistance, when in motion, would be reduced to one-quarter of this, or to two thousand pounds, hence a locomotive whose maximum tractive power would be two thousand pounds would be able to keep such a train of cars in motion, on a level road, but would not be able to start the train. Starting one car after the other, supposing that slack enough existed in the connections, it would only be able to start seven cars. Six being in motion would absorb twelve hundred pounds, while the seventh, being at rest, would require the remaining eight hundred pounds. To start the ten cars, the locomotive would require to have a tractive power of twenty-six hundred pounds, because, after nine are in motion, the resistance of each falls to two hundred pounds, or eighteen hundred pounds for the nine, while the resistance of the tenth, which is at rest, would be eight hundred pounds. The starting of the entire train, from a state of rest, if rigidly connected, would therefore require a little more than three times the power necessary to start the train if not rigidly coupled.

In the case of starting a single mass, like a ship, upon a single car, the same principles would apply. If we assume the weight to be six thousand tons, and the resistance to be twenty pounds to the ton, the tractive power necessary to start the car would be one hundred and twenty thousand pounds, while the power necessary to keep it in motion would be about only one-fourth as much.

It is plain, then, that the power required in either case is simpiy a question of area of piston pressure per square inch upon it, and of leverage exerted by the crank and wheel upon the axles. In railroad practice, locomotives invariably have a large surplus of power over that which is necessary to keep the train in motion; and while the locomotives necessary to simply start six ordinary trains weighing one thousand tons each would need an aggregate tractive power of less than forty thousand pounds, those necessary to start six thousand tons in one mass would require a tractive force of one hundred and twenty thousand pounds, or more than three times as much; but after these respective masses were once in motion, the tractive power required by the locomotive of each would be the same, hence the actual cost of hauling the loads or the fuel consumed would be the same for each six thousand tons. It does not follow, however, that the locomotives for the six trains would be limited to a tractive power of forty thousand pounds; on the contrary, a large surplus over that would be required to insure the certainty of starting promptly, for the reason that there are no perfectly level railroads in operation, and wherever grades intervene, additional power is required by the locomotives, to ascend such grades, and this additional power would be no greater in the case of the ship railway than in that of an ordinary railroad. A grade of one foot in a hundred would increase the tractive power required to an amount equaling one per cent of the load, which, for six thousand tons, would be sixty tons, or one hundred and twenty thousand pounds additional to that which would be required to start the ship, or a total of two hundred and forty thousand pounds to start it upward on such a grade.

The engines employed by the ship railway would, no doubt, have four cylinders each, and three locomotives would doubtless be employed to haul a load of six thousand tons. This would be equivalent to twelve cylinders, and, supposing one-half of the cranks actuated by the pistons in those cylinders to be at the dead point, there would still be six pistons in full force.

Let us assume the wheels to be five feet in diameter, and the stroke thirty inches, and cylinders twenty-eight inches bore; we would then have, on six pistons, an aggregate area of three thousand six hundred and ninety square inches, which, with one hundred and twenty-five pounds pressure, would be equal to four hundred and sixty-one thousand two hundred and fifty pounds. Let us suppose that only one-third of this is converted into tractive force through the loss of leverage in the cranks and wheels; we would have one hundred and fifty-three thousand seven hundred and fifty pounds of tractive power to overcome the resistance of one hundred and twenty thousand at starting. On grades of one per cent, three more locomotives would be required to start the load upward, when standing on such grade.

This would insure an abundance of power to start the car, and, after it was started, the steam could be worked expansively, and with greater economy, at an average pressure of thirty or forty pounds to the square inch.

It is, therefore, only necessary for the ship railway to provide somewhat larger cylinders than are ordinarily used on locomotives to insure the surplus pressure necessary to overcome the resistance to starting the cars, while, as we have said before, the consumption of coal during the trip would be no greater than if six trains, weighing one thousand tons each, and composed of ordinary cars, were beinghauled over the same line.

The pressure upon the piston at the time of starting is usually equal to that in the boiler, the valve being wide open, while the pressure upon the piston when the train is in motion is much less than the maximum pressure in the boiler.

In the case of the ship railway, it would be found practicable to use the steam more expansively than in ordinary railway practice, and this would tend to greater economy of fuel.

PHOTOGRAPHIC NOTES.

IMPROVED PYRO DEVELOPER FOR LANTERN SLIDES.

The use of ferrous oxalate developer, considerably restrained with bromide of potassium and citric acid, in the development of lantern slides on gelatine plates, has been invariably recommended by manufacturers, for the reason that there was no danger of staining the film, and in consequence greater ease in obtaining clear, crisp pictures; but if the exposure had been too short, and forcing of the developer was rendered necessary by additions of the iron solution, a disagreeable precipitate of the ferrous oxalate would occur over the surface of the film, thereby injuring it.

As pyrogallic acid is now largely employed in the development of negatives, its possible use as a developer for transparencies would add much to the convenience of the amateur, in avoiding the necessity of his having two kinds of chemicals, viz., one for negatives and one for positives.

Recently it has been found that a freshly made pyro solution answers admirably as a developer for lantern slides, and we can recommend the following formula as being reliable:

Saturated solutions of citric acid, chemically pure sulphite of soda, and chemically pure carbonate of soda are first prepared. Then a solution of either bromide of potassium or ammonium in the proportion of 1 ounce of the bromide to 4 ounces of water.

The developer is mixed in the following order:

Water	3 ounces.
Sulphite soda solution	1 ounce.
Citric acid solution	5 minims.
Bromide of potassium solution	10 minims.
Dry pyrogallic acid	8 grains.
Carbonate of soda solution	1 drachm.

This is poured upon the exposed plate or plates (for several may be developed at one time in a tray), and the effect watched. After a minute's soaking, should no image appear, another drachm of the soda solution is added and continued to be added in small amounts until some action occurs.

The picture develops gradually, or in about one-third that required by the oxalate developer; and if a slow brand of plate be used, not a trace of stain or fog can be seen. As soon as the details in the high lights appear well out, which is judged by the surface appearance of the picture on the film, the plate should be removed, washed in changing water for two or three minutes, and then fixed in a fresh hypo bath.

After again washing, it is immersed in a clearing bath for three minutes.

CLEARING SOLUTION.

Saturated solution of alum	20 ounces.
Sulphuric acid	1 drachm.

Then washed in changing water for one hour and allowed to dry.

The peculiarity of this developer is that it imparts to the image, at once, without further toning, a rich, warm, brown color, so desirable for lantern slides. By giving a long exposure with a well restrained developer the best result is obtained. Too short an exposure changes the color to a blacker brown.

For contact printing, an exposure of 10 seconds three feet from a gas or kerosene light is advised. When reducing in the camera by diffused daylight, from 10 to 30 seconds is sufficient. With lamp light diffused by a ground glass, the exposure may range from 45 seconds to 3 or 4 minutes, according to the density of the negative and the size of stop employed in the lens.

While it is safer to use the developer but once, we have found it practical to develop from two to three plates in rapid succession in but one ounce of developer. One of the advantages of this developer over the ferrous oxalate is that it may be strengthened by the addition of the carbonate soda solution without producing any precipitate.

Capt. Abney's Method of coating Paper with Gelatine Emulsions.—From the *Photographic News* we glean the following particulars respecting Captain Abney's process:

The sheet of moist Saxe paper is laid on a glass plate somewhat larger than is necessary, having its edges cemented to the glass with a solution of gelatine and water. The paper is then allowed to dry, and in shrinking becomes as smooth and even as the glass itself. It is then coated with the emulsion the same as an ordinary glass plate, and allowed to set and dry. He states it is just as easy to coat paper as glass. The emulsion used contained about 5 per cent of glycerine, or 50 cubic centimeters of glycerine were added to each liter of emulsion. Owing to the repellent character of the glycerine in the emulsion to the developer, he found it necessary to immerse or draw the paper through a bath of glycerine, composed of one ounce of glycerine to twenty of water, before developing.

To Detect any Yellow Tinge in Lenses.—If lenses are long exposed to the light, the glass sometimes becomes very slightly yellowed, which affects the rapidity of the lens, since it prevents the passage of the most active rays. To detect the yellow hue—says the *Photo. News*—lay the lens upon a piece of paper of a very pale blue tinge—such as blue foolscap—when even a very slight degree of yellowness will be easily perceived.

William H. Guild.

The death of William H. Guild, of the firm of Guild & Garrison, steam pump manufacturers, of Brooklyn, which occurred on November 11, removes from the mechanical world one who had greatly endeared himself to his colaborers and a large circle of friends for his ability as a mechanician, uprightness as a man, and cordial disposition as a friend. He was born in Connecticut, and had reached the age of fifty-three years. At the age of sixteen he located in Brooklyn, and learned the trade of machinist as connected with the manufacture of steam pumps. His father was one of the original firm of Guild & Garrison, and William H. succeeded to his place at the time of his death.

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THE ST. MARY'S FALLS CANAL.

(*Continued from first page*).

They were actually begun in 1837, but the history of these is too long to be here given.

In 1853 the State of Michigan accepted the land grant, and soon afterward made a contract with a private company which undertook to build the canal, and to take the granted lands in payment therefor. The surveys for and the plans of the canal and locks were made under the direction of the late Captain Augustus Canfield, Corps of Topographical Engineers, U. S. A., and the company promptly began operations.

On the 18th of June, 1855, the completed canal was opened to navigation, the company having expended in its construction nearly $1,000,000. In view of the large amount of capital required, no return being possible until after the sale of the lands, the isolation of the locality, inaccessible during the five months of winter, and the severity of the winter climate, which greatly retarded operations, the rapid construction of the canal was a remarkable feat. This was the first ship canal made in the United States. The locks and gates were the largest built in the country up to that time. The depth of water was greater than had been called for in any American canal.

The engineering features were thus without precedent in American practice, but they were well worked out, and the canal proved a remarkably successful one. It was 5,400 feet long, had a width of 100 feet at the water line, with slopes of 1½ to 1, paved where the cutting was not through rock, and a depth of 12 feet at mean stage of water. The locks, located near the foot of the canal, were two in number (now known as the "old locks"), combined, each 350 feet long, 70 feet wide, with a lift of 9 feet, with 12 feet of water in the miter sills. At the time the canal was made, it was deemed of ample capacity to meet the needs of commerce through all future time. The depth was sufficient to pass any vessel on the Lakes, fully laden. The locks were large enough to contain at one time a tug and three vessels, of the average size then in use, which generally constituted a "tow."

By the year 1870, owing to the general improvement of channels and harbors on the Lakes, these dimensions no longer sufficed.

The size of vessels had increased, and they were no longer able to carry full loads on a draught of 12 feet; only one of the largest vessels could be passed at one lockage, and the number of vessels engaged in the Lake Superior trade had increased so greatly that they were frequently delayed at the locks several hours. It became necessary to provide for more rapid lockage, and for the passage of larger vessels. The slope walls of 1½ to 1 had been found objectionable, as vessels frequently came in contact with them below the water line, and sustained damage.

In July, 1870, Congress made an appropriation for beginning improvements, and the charge assigned to General O. M. Poe, of the Corps of Engineers, who in August following submitted a project therefor. The project promptly received the approval of the Chief of Engineers. After some modifications it embraced the following points, viz.:

Build a new lock opposite the old locks, parallel to them, at a clear distance of 100 feet. Take down the guard gates with their masonry, and rebuild them 700 feet nearer the head of the canal, and at a lower level. Form entrances at the new lock—at the foot, by excavating out to deep water, and revetting the channel with pier work: above, by widening the canal from the new lock to the new position for the guard gates. Remove the slope walls, and use a timber revetment with a nearly vertical face. Where the cutting was through rock, the revetment to be placed on the first sound rock reached. Below the base of the revetment, the rock to be cut to a slope of one horizontal to four vertical; where no rock was found, the revetment to be built from the new grade of canal bottom. The improved canal to be made 16 feet deep at ordinary stages. At the time the canal was originally made, it was feared that in the spring of the year ice might be driven into it at the head to such an extent as to delay its opening for navigation. To guard against this, a curve was made near the upper end, so that the direction of the canal above the curve was nearly normal to the direction of the current in the river, which is quite rapid here. This rendered the entrance difficult to a single vessel and impracticable to a tow of three or more. Experience showed that there was really no danger to be apprehended from the ice. The direction of the upper entrance was therefore changed so as to make the canal straight. At the completion of the new lock, replace the guard gates by a movable dam.

Fig. 3.—MAP SHOWING LOCATION OF ST. MARY'S FALLS.

From its beginning to May 1, 1873, the work was in charge of General O. M. Poe, Corps of Engineers, U. S. Army, and from that date to completion in charge of the late General G. Weitzel, of the same corps.

From October, 1870, to completion, the local engineer was Mr. Alfred Noble, to whom the greatest credit is due for the accomplishment of this magnificent work.

The effect of the canal improvement is shown by the fact that the commerce has increased from 1,567,741 tons of freight in 1881 to 3,300,000 in 1885. That is, it has more than doubled in four years.

It is now proposed to further improve the canal by making it 20 feet in depth, and replacing the "old locks" of 1855 by a single one having horizontal dimensions equivalent to the *two*, and a depth on the miter sills of 21 feet.

It is not proposed to disturb the new lock (of 1881), but the increased depth of the canal prism will make available the full depth of 17 feet on its miter sill.

The new lock (of 1881) seems to be nearly perfect. After five years of use, there is no improvement to be suggested. Its operation is rapid, quiet, and in every way satisfactory. It has attracted more attention abroad than at home, especially among the Germans and Russians. Only a couple of weeks ago General Barminsky, of the Imperial Russian Engineers, visited it and fully investigated its operation, devoting a couple of days to the inspection, and upon the conclusion remarking that it is the most effective work of its kind in the world.

The relative positions of the new and old locks are shown at F and E E respectively on the map, Fig. 4. The chamber of the new lock is 515 feet long between the hollow quoins and 80 feet wide, narrowed to 60 feet at the gates; the depth is 39½ feet. Its capacity is 1,500,000 cubic feet. The lift of the lock is 18 feet, and the depth of water on the miter-sills 17 feet. The sills are placed 1 foot below the canal bottom, so as to be protected from injury by vessels. A guard gate is placed at each end of the chamber, making the length of the walls 717 feet. The walls for 14 feet from each end are 13 feet wide from top to bottom; then for 121½ feet at the west end and 133½ feet at the east end they are 25 feet wide from top to bottom. Between the wide walls the width is 18 feet for 10 feet up from the foundation, then it narrows in 2 feet for four offsets, 5 feet apart vertically, until the wall is 10 feet wide, at which width it is carried up to within 6 inches of the top of the coping, which is 5 feet wide, as shown in the plan view of the lock, Fig. 5. The masonry is all laid in cement mixed with sand in the proportion of 1 to 1. About 35,000 barrels of cement were used in the construction of the 34,207 cubic yards of masonry.

In the miter walls for the upper lock and guard gates there are nine courses of cut stone, each 2 feet thick. The walls are 14 feet wide at the miter angle, are arched to resist the pressure on the gates, as shown at the right in Fig. 5, and are bonded into the lock walls. The top course of stone is set back 1 foot, so as to leave an offset, on which the oak miter sills rest; these sills project 2 inches above the masonry.

The foundation is on rock throughout. In excavating the lock pit, rock was reached at from 1 to 15 feet above the grade of the lock floor. A floor of timber and concrete extends across the bottom of the lock and 5 feet under each wall; the rest of the wall foundation is concrete, one-half to 2 feet thick on the rock. All the foundation timbers are of pine, 1 foot thick. The miter sills are of oak, 12 x 18 inches, and are held in place by bolts, 10 feet long, fox-wedged and concreted in the rock, and also by timber braces bolted to the rock.

The positions of the four gates, designated as upper and lower lock gates and upper and lower guard gates, are shown at P Q R S, respectively, in Fig. 5. The guard gates are only for use when repairs are being made to the lock; they are opened and closed by means of temporary block and tackle operated by a power capstan. Both leaves of the upper guard gates are provided with valves through which to fill the lock after it has been pumped out. The framework of the gates, shown closed in Fig. 1, is of white oak, and the sheathing is of Norway pine. The weight of one leaf of the upper lock gate is 40 tons, and of one leaf of the lower lock gate 76 tons. Each leaf is thoroughly braced by transverse and diagonal rods, and around each end post are straps bolted to the cross pieces.

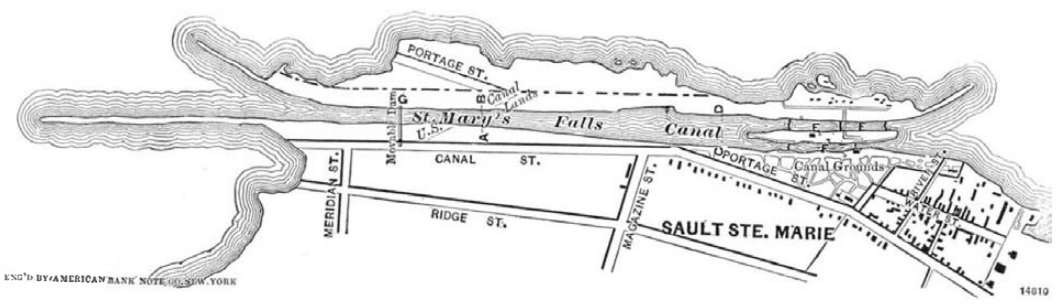

Fig. 4.—MAP SHOWING OLD (E) AND NEW (F) LOCKS AND MOVABLE DAM.

Water is let into the lock from culverts under the floor extending from the well, X (Fig. 5), above the upper lock gate to the well, Y, above the lower lock gate. The two culverts are separated by a longitudinal bulkhead, and each is 8 feet square. The floor of the lock forms the roof of the culverts. The water passes into the lock chamber through 58 apertures in the floor, shown in Fig. 5. The total area of these apertures is 174 square feet; this outlet area is increased to 190 square feet by manholes left in the bulkhead at the lower end of the culverts. The combined area of the cross sections of the two culverts is 128 square feet. Having the inlet area considerably less than that of the outlet tends to diminish the velocity of the water when projected upward into the lock chamber. The water in passing out of the lock goes down through the well, Y, which, as well as the well, X, is covered with a grating, thence through short culverts and up through the well, Z.

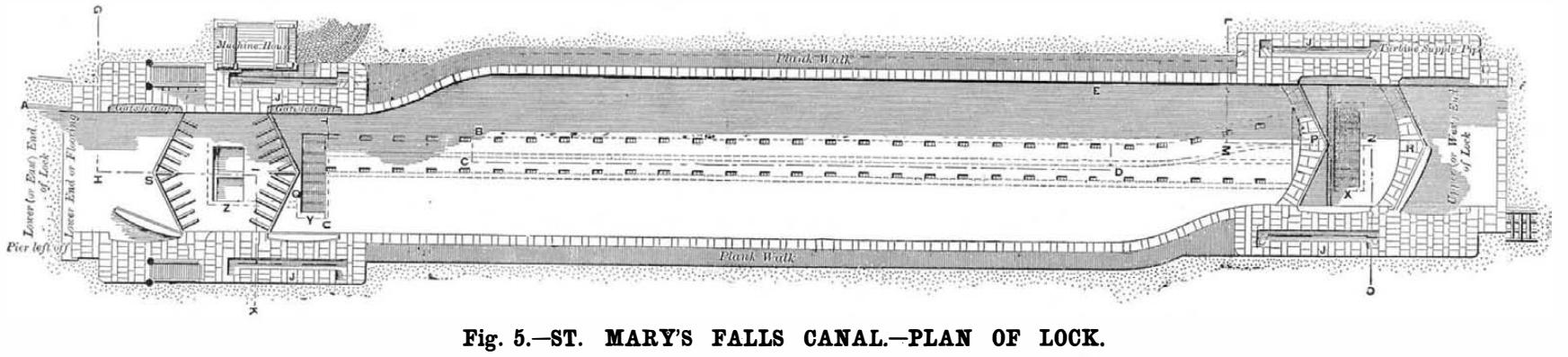

Fig. 5.—ST. MARY'S FALLS CANAL.—PLAN OF LOCK.

The water enters the lock through filling valves, A A (Fig. 6.), located in the well just above the upper lock gate. Each valve, when shut, closes the entrance to one of the culverts. Each valve is 10 feet wide by 8 feet deep, so that when open it gives a clear aperture greater than the cross section of the culvert. Bolted to the woodwork at the culvert is a heavy iron frame in which the axle of the valve has bearings. The valve

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consists of a cast iron frame covered with boiler iron and made of such size as to leave a space of ¼ inch at the edges between it and the rectangular frame. Lugs projecting from one face of the valve carry the end of a pitman joining the end of a piston rod operated by water entering the cylinders, L, Fig. 6. Water from the accumulator, described below, can be admitted to either end of the cylinder, which is 15 inches in diameter. The two emptying valves are similar in construction to the filling valves, and are located in the well just above the lower lock gate. Each culvert is complete in itself, so that if an accident should occur to one, or to its valves or engines, the other could still be used.

The power is obtained from two 30 inch turbines, geared to a main shaft, and fed through a supply pipe, B C, Fig. 6, from the canal above the lock. A belt from the shaft runs two force pumps, each having three plungers, which pump into an accumulator loaded so as to give a pressure of about 120 pounds to the square inch. Water is taken from the accumulator to the engines operating the gates and valve.

The interior diameter of the accumulator cylinder is 21 inches, its length 124 inches, and its capacity is 1,859 gallons. The plunger carries a heavy crosshead moving up and down on guides fastened to the iron girders of the machine house. The weight case is suspended from the crosshead by rods. The weights are cast iron plates made to fit the weight case. As the area of the cross section of the cylinder is 346 square inches, it requires 69,200 pounds of weights to produce a pressure of 200 pounds to the square inch. The water enters and leaves the accumulator at diametrically opposite points at the base. When the accumulator is full, the belts which run the pumps are automatically thrown on loose pulleys.

The position of the four gate engines is shown at J J J J, Fig. 5. The interior diameter of the cylinder is 15 inches, and the length 132 inches. The piston rod projects from both ends of the cylinder, as shown in Fig. 6. Water is taken from the accumulator, and is admitted through pipes to either end of the cylinder, and controlled by hand valves. Each crosshead is constructed with two sheaves. One end of a wire rope is adjustably fastened at I, Fig. 6, and, passing around one of the engine sheaves, is led by suitably located sheaves down through the well in the lock wall, around the drum, Q, and to a leaf to which it is secured. The four ropes necessary for the opening and closing of each gate are clearly shown in Fig. 6. When the engine makes a stroke, the end of the rope attached to the gate moves four times as far. With a pressure of 200 pounds per square inch, the total pull on the leaf of the gate is 8,835 pounds, less friction and rigidity of rope. It will be noticed from the drawing, Fig. 6, that each closing rope is attached to the leaf at the opposite side of the lock. Hand power capstans can be used in case the gate engines are disabled.

The centrifugal pump for emptying the lock is run by a belt connected with the main shaft. A power capstan, located on the lock wall near the machine house, Fig. 5, is run by belts from the main shaft, and is used for warping vessels into and out of the lock.

The location of the movable dam, shown in perspective in Fig. 2, is indicated on the map, Fig. 4. It is about 3,000 feet above the locks, and is designed to check the flow of water so that the upper guard gates could be closed if the lock gates were accidentally carried away. It consists of an ordinary swing bridge, one end of which can be swung across the canal. A series of wickets, Fig. 7, are suspended side by side from a horizontal truss hung beneath the bridge and abutting at either end (when the bridge is closed) against heavy buffers securely anchored to the masonry. One end of each wicket can be let down until it rests against a sill, O, in the bottom of the canal. When the wickets are all down, they form a vertical bulkhead or dam, as shown in Fig. 2.

Each of the twenty-three wickets is supported in an iron frame, and turns on an axle, H, and is let down and drawn up by chains attached to each end as shown. Each wicket frame is hinged upon a shaft passing through its upper end. The operating ropes are wound upon windlasses, K, provided with pawls and friction brakes. A wicket fully drawn up is shown at L, another in the act of dropping into position is shown at G, and another after it has been dropped at G, Fig. 7. In dropping a wicket, the down stream end is first let go until it strikes the water, the up stream end is then let go by the run, and the frame swings down until this end strikes the sill, the wicket then lying horizontally in the water and presenting only its end surface to the current. The wicket is then drawn into a vertical position by the chain at its down stream end. When the wickets are in position, there is a space of one inch between the frames. The axle, H, is so placed as to leave the pressure of water on the upper and lower parts of the wicket nearly equal. The dead weight on the truss due to the wickets and frames is 1,600 pounds per running foot, which is counterpoised by brickwork at the other end of the truss.

The total amount expended upon this improvement, up to June, 1885, is $2,400,000.

We wish to acknowledge our indebtedness to Gen. O. M. Poe, by whom these improvements were planned and under whose direction the work has been most successfully carried to completion, for notes and drawings.

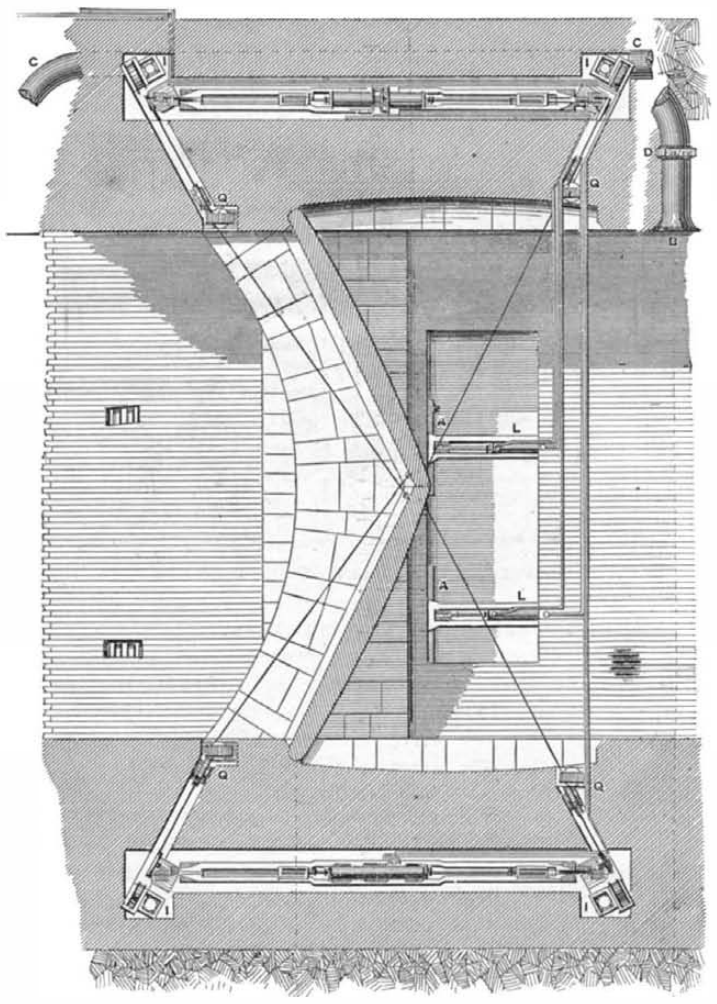

Fig. 6.—PLAN OF UPPER LOCK GATE, SHOWING OPERATING MACHINERY.

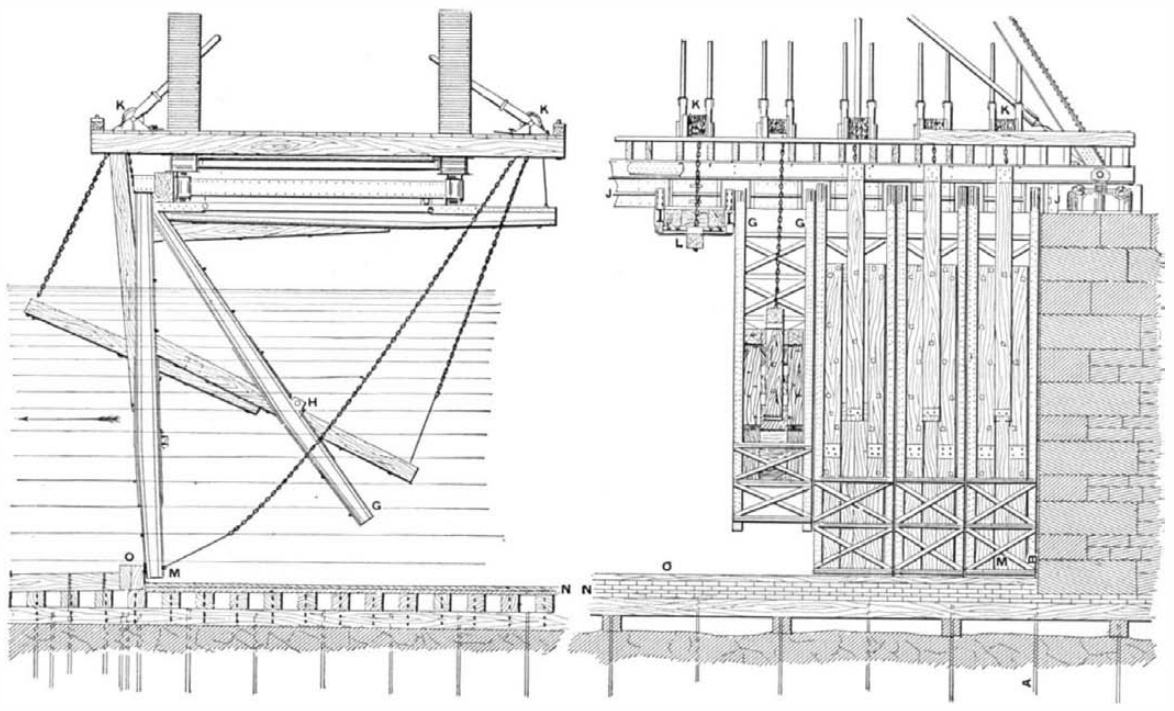

Fig. 7.—THE MOVABLE DAM.—SHOWING THE ARRANGEMENT OF THE WICKETS.

COCAINE, like fire or alcohol, is again proved to be a good servant but a bad master. A Chicago physician addicted to its use experimented not only upon himself, but upon his wife and children, until he is a raving lunatic and they are incurable wrecks.

Engineering by the Ancients.

At the meeting of the British Association, the president of the section on Mechanical Science, B. Baker, civil engineer, recalled certain engineering feats of the ancients: "I have no doubt that as able and enterprising engineers existed prior to the age of steam and steel as exist now, and their work was as beneficial to mankind, though different in direction. In the important matter of water supply to towns, indeed, I doubt whether, having reference to facility of execution, even greater works were not done 2,000 years ago than now. Herodotus speaks of a tunnel, 8 feet square and nearly a mile long, driven through a mountain in order to supply the city of Samos with water, and his statement, though long doubted, was verified in 1882 through the abbot of a neighboring cloister accidentally unearthing some stone slabs. The German Archæological Society sent out Ernst Fabricius to make a complete survey of the work, and the record reads like that of a modern engineering undertaking. Thus, from a covered reservoir in the hills proceeded an arched conduit about 1,000 yards long, partly driven as a tunnel and partly executed on the 'cut and cover' system adopted on the London underground railway. The tunnel proper, more than 1,100 yards in length, was hewn by hammer and chisel through the solid limestone rock. It was driven from the two ends like the great Alpine tunnels, without intermediate shafts, and the engineers of 2,400 years ago might well be congratulated for getting only some dozen feet out of level and little more out of line. From the lower end of the tunnel branches were constructed to supply the city mains and fountains, and the explorers found ventilating shafts and side entrances, earthenware socket pipes, with cement joints, and other interesting details connected with the water supply of towns."

Two Forms of Liquefied Air.

In a recent communication to the *Comptes Rendus* on the liquefaction of air, Herr S. Wroblewski states that he has obtained from air two liquids, different in appearance and in composition, which can exist together as separate layers with a perfectly visible meniscus between them. To obtain this result, Herr Wroblewski liquefied at —142° C. a certain quantity of air in the tube of the apparatus which he employs for using permanent gases as cooling mixtures. He then allowed a quantity of gaseous air to enter the tube, so that, the pressure of the gas having become equal to 40 centimeters, and its optical density the same as that of the liquid, the meniscus entirely disappeared. He then slowly lessened the pressure, and at the moment when the gauge indicated a pressure of about 37·6 atmospheres, he saw a new meniscus formed at a point in the tube much higher than the place previously occupied by the vanished meniscus. A few minutes afterward the first meniscus reappeared at the place where it was seen to disappear, and at the same moment two liquids, different in character, were distinctly seen, one on top of the other. The liquids remained separated for several seconds. Afterward a current of very small bubbles formed and ascended, detaching themselves from the meniscus separating the two liquids.

In consequence of this phenomenon, the upper liquid became a little opaque; the meniscus, gradually destroyed by the current, ultimately disappeared altogether; and the last result was a single liquid homogeneous in appearance. In this experiment, air (which is a completely colorless liquid) presents an enigmatical optical phenomenon, which immediately precedes the appearance of the upper meniscus. This part of the tube assumes a feebly orange coloration, which vanishes immediately upon the formation of the meniscus. Nothing like this ever precedes the formation of the lower meniscus. By means of a small metal tube introduced into the apparatus, Herr Wroblewski has succeeded in taking at will a sufficient quantity of either the top or bottom liquid for analysis. While the lower liquid contained 21·28 to 21·50 parts of oxygen, the upper one only contained 17·3 to 18·7 of the same element.

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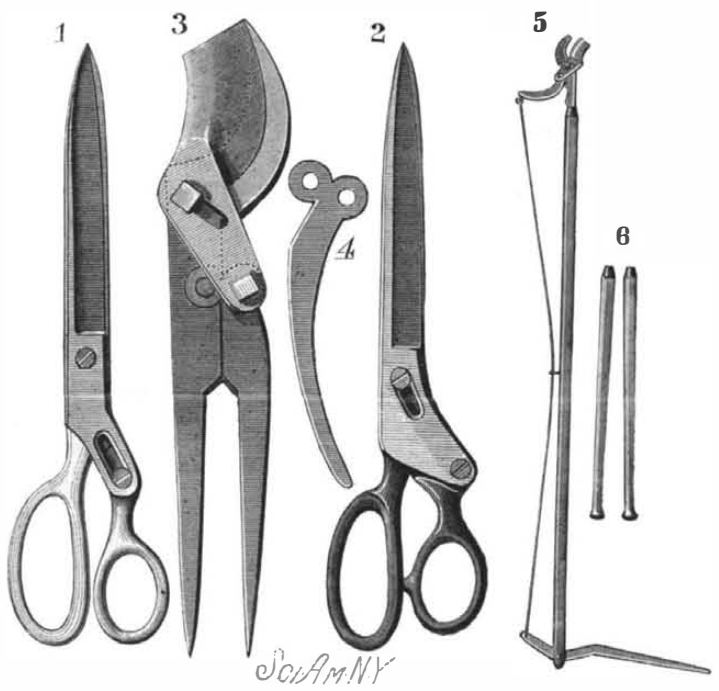
PRUNING AND HOUSE SHEARS.

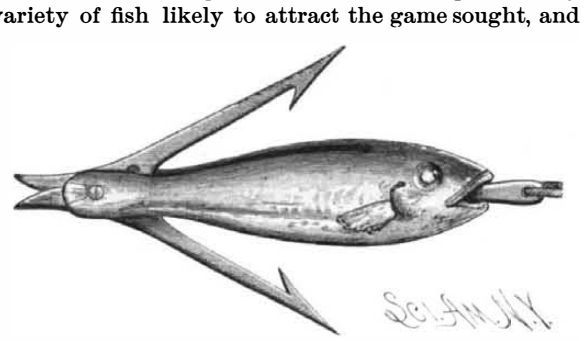
The accompanying illustrations show the improved pruning and housekeeper's shears recently invented and patented by Messrs. Wilsey & Holcomb, of Bloomville, Ohio. Fig. 1 represents the housekeeper's shears, which are so constructed as to derive increased power and cutting capacity from double leverage. The lower end of the short shank handle, being attached to the main blade just back of the pivotal screw, forms a leverage, so that as the shears are closed the screw in the slot increases the distance from the fulcrum, and the power and cutting capacity are thereby materially increased. Fig. 2 represents another style of house shears, constructed on the same principle as Fig. 1, only the short shank handle has a cam on the lower end that fits into a recess on the inside of the main blade, by which it is held in place. The upper end of the main blade is attached to the lever handle, and has a slot that works backward and forward on the pivotal screw in the slot, that gives the blade a drawing motion, thereby greatly adding to the cutting capacity. In the pruner, Fig. 3, increased power is obtained by compound levers in connection with a drawing cut. This gives it great force, and it is stated that with it an inch and a half limb can be most easily cut. Fig. 4 is an extra lever piece, intended to be used on the pruner in connection with a long single handle, as shown in Fig. 5. By removing the bolt in the lower end of the pruner blade, the straight lever can be easily detached and the crooked shank put in its place. This is operated by a wire secured to a swivel in its outer end and extending to a short lever in the bottom end of the long handle. This change can be quickly effected, and with the long handle the operator can, while standing on the ground, trim fruit and shade trees of medium height. Fig. 6 shows the handles intended for the pruner shown in Fig. 3. The patentees will furnish particulars concerning the manufacture of these shears.



ECLIPSE PRUNING AND HOUSE SHEARS.

IMPROVED FISH HOOK.

The engraving shows a combined hook and bait which is simple in construction, alluring in appearance, and effective in operation. The body of the artificial fish is shaped and colored to represent any variety of fish likely to attract the game sought, and

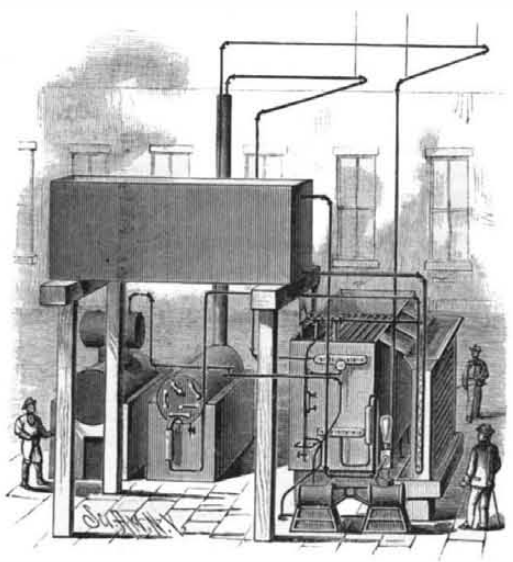


LIE'S IMPROVED FISH HOOK.

is composed of two parts hollowed out and cut away on their meeting faces sufficiently to contain the working mechanism and hooks. The line is attached to a flat bar passing through the fish. The lower ends of two fish hooks of the ordinary pattern are pivoted to the lower end of this bar, and are formed with slots, through which passes the rivet uniting the lower ends of the two parts of the bait; these slots are so inclined that, when the fat bar is pulled, the points of the hooks are spread out as shown in the cut, but, when there is no strain upon the line, the hooks are kept concealed within the sides of the bait by a spring that presses the bar downward. The greater the tension on the line, the farther out will the points of the hooks be thrown, and the more securely will the fish be held. The rear ends of the hooks are curved to form a homocercal tail, so that, when the bait is seized, the pressure brought upon the tail will spread the hooks. This hook is the invention of Mr. Cornelius Lie; the patent has been assigned to Mr. J. J. Eskil, of Florence, Wis., who will furnish further information.

LUSCHER'S ICE MACHINE.

In ice machines using ammonia as a refrigerant, it has hitherto been introduced directly from a still to the coils in the cooling tank. This resulted, however, in a constant back pressure in the absorber of from 25 to 35 pounds. This prevents the free expansion of the gas and its complete absorption by the liquid.



LUSCHER'S ICE MACHINE.

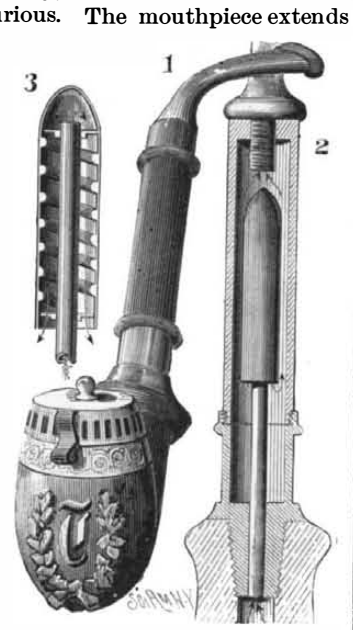
In the improved form illustrated, which was recently patented by Mr. Sigmund Luscher, of Frankfort, Ky., this defect has been remedied. The ammonia is pumped from the receiver into a stand pipe and still, where it is heated by steam. The hot vapor of ammonia generated is converted into anhydrous ammonia in the coils of the cooling tank, and is then fed into the pipes of the refrigerating tank.

After performing its work, the expanded gas is returned to an absorber, being introduced at a point in advance of where the weak ammonia from the receiver enters.

An injector is thus formed by which the weak ammonia is drawn in. The gas is thus almost entirely absorbed, and the back pressure is reduced to a minimum. This permits the gas contained in the pipes of the refrigerating tank to expand freely, the ammonia in the absorber is strengthened before its return to the still for redistillation, and the mixing of the gas and weak ammonia assists in cooling the heated vapors.

TOBACCO PIPE.

This pipe is so constructed as to collect and hold the nicotine, and to cool, purify, and render the smoke more agreeable and less injurious. The mouthpiece extends through the cap and projects a short distance into the upper end of the body, as shown in Fig. 2. Secured to the lower section of the body is a small tube, which extends upward and terminates within a short distance of the upper, closed end of a larger return tube, shown in section in Fig. 3. To the central tube are fitted two perforated diaphragms, through which the smoke passes; and to the interior of the return tube is fitted a spiral to retard the smoke. By this construction of a pipe in sections, economy of material, and facility of assembling the several parts are obtained. The manner of uniting the several parts and the course taken by the smoke in passing from the bowl to the mouthpiece will be understood from the second and third figures. The smoke is cooled during its passage, and the nicotine is collected in the recess in the lower section, from which it can be removed at pleasure.



TAPPE'S TOBACCO PIPE.

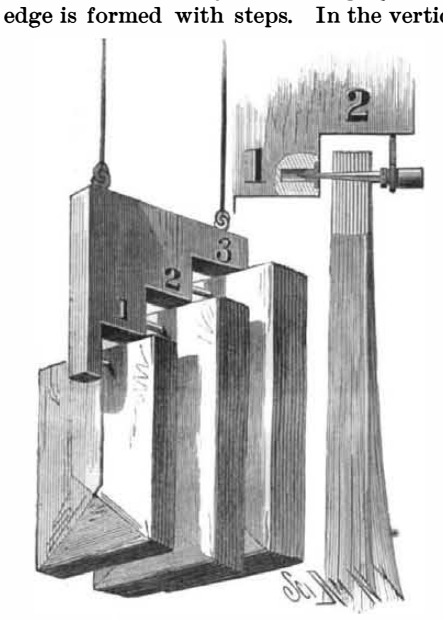
This invention has been patented by Messrs. August and Charles Tappe, of Bloomington, Ill.

A New Method of Introducing Medicine into the System.

At a meeting of the French Academy of Medicine, held September 22, M. Brondel read a paper on the introduction of certain medicines into the system by means of electricity. If the electric current is made to pass through a solution of a salt, the salt is decomposed, the metallic base passing to the negative pole, and the acid, or metalloid, to the positive pole. The iodides are easily decomposed by electricity. In order to introduce iodine into the system, a rubber plate, moistened with a solution of iodide of potassium, is placed upon the surface of the body. Over this plate the negative pole of a battery is applied, while the positive pole is placed upon a part of the body toward which it is desired that the iodine travel. The iodine separates from the potassium, which remains at the negative pole, and passes with great rapidity through the tissues toward the positive pole. This may be demonstrated by testing with a starched paper, which becomes blue. A great number of substances can thus be made to traverse the tissues, and the applications of this discovery are numerous and important. M. Brondel has in this way cured uterine fibroids, a case of perimetritis, rheumatic ovarian neuralgia, and several cases of chronic rheumatism.—*Le Progres Medical.*

PAPER BAG HOLDER.

The holder herewith illustrated is adapted to hold a number of paper bags of different sizes. The top edge of the board has eyes for hanging it, and the lower edge is formed with steps. In the vertical part of each step is a recess containing a cap for receiving the end of a pin whose other end is supported by a hook secured near the outer edge of the horizontal part of the step, as shown in the sectional view. Each pin has a head formed with an annular groove to receive the hook. The pin is driven through the upper ends of the bags, and then the point is passed into the cap, and the head is hung on the hook. The bags can then be pulled from the pins, which, to prevent tearing of the paper, are made diamond shape in cross section. The different sizes of bags are arranged as shown in the perspective view.

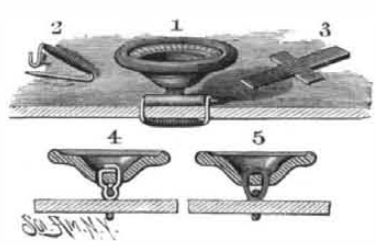


MARTIN'S PAPER BAG HOLDER.

This invention has been patented by Mr. Edward T. Martin, of Concordia, Kansas.

BUTTON FASTENER.

This device is for fastening buttons of all kinds on garments, shoes, etc., in a perfect manner, and so that they can easily be removed when desired. The fastener consists of a safety pin formed as shown in Fig. 2. The button is provided with a thread loop, or with a loop formed by means of a metal strip, shaped as shown in Fig. 3; the ends are passed through slots in the button, and the side tongues are bent to form a loop (Fig. 4) on the under side of the button. The shank and hook of the pin are passed through the fabric, and the shank is passed through the loop, thereby holding the button securely, as shown in Fig. 1. The shank is wound to prevent the discoloration of the fabric. Fig. 5 shows the button provided with a thread loop. The fastening is not liable to tear out, as the entire length of the shank rests against the fabric.



IRVINE'S BUTTON FASTENER.

This invention has been patented by Mr. Albert G. Irvine, of Gloucester City, N. J.

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Correspondence.

The Great Ship Railway.

To the Editor of the Scientific American:

A question concerning the details of the Eads ship railway has arisen in my mind which cannot be answered from any examination I have been able to make among your articles on the subject. When a locomotive begins to pull a heavy train, it is necessary that the connection between the cars should have some slack or spring. Otherwise the most powerful engine could not overcome the quiescent inertia of the train. I think you will get my idea by this mere allusion, without any lengthy theoretical discussion.

It appears to me, from your illustrations of the ship railway, that the trucks are placed under a rigid framework which supports the vessel, and that when the engines begin their journey they must start the whole mass at once. Please state whether I am correct or have overlooked something in the description.

C. K. NEEDHAM.

Orlando, Fla.

Fall of Celestial Bodies.

To the Editor of the Scientific American:

Mr. E. B. Whitmore, in his query "Can a Celestial Body fall to the Center of its Attraction?" seems to overlook the fact that Newton's laws refer to the path described by the *center* of the body; and that the aphelion of a body's orbit may be very near or even beneath the surface of another body, in which case there must be a collision, as when meteors strike the sun, and as would be the case were the earth suddenly stopped in its orbit.

From this standpoint he will see that there is no antagonism between the laws of the orbits and the possibility of a collision.

Returning to the query, I think that, of two spheres alone in space, the center of neither one can reach the center of attraction, while of three or more bodies, the center of any one may pass through the center of attraction.

H. D. WILLIAMS.

Stamford, Conn., Nov. 26, 1885.

Cross Tie Timber.

To the Editor of the Scientific American:

In the SCIENTIFIC AMERICAN of Nov. 21, page 320, there is an article under the heading "Durability of Cross Tie Timber," in which the following error occurs, viz.: "Assuming that the average durability of ties is seven years and the distance apart is three feet, there will be 2,640 to the mile." If the distance apart were two feet, which I suppose was meant, the figures would be correct.

In this connection let me ask you if you do not think it probable that in the near future railroads will be constructed without perishable wooden cross ties?

Already I believe street railroads are constructed without timber, and in many of our best modern buildings iron has taken the place of timber.

In discussing the timber question, I think this should not be overlooked.

Under any circumstances, however, the timber question is an important one, and I am glad that it begins to receive attention.

P. BARRY.

Rochester, N. Y., Nov. 25, 1885.

The Dolbear Telephone Case.

To the Editor of the Scientific American:

In the SCIENTIFIC AMERICAN of November 28, in the article on the Reis telephone, there is a quotation from the judgment of Judge Gray in the Dolbear case, in which is the statement that it was not denied that "Bell was the first inventor of a speaking telephone." This statement is ambiguous, and may be understood in two ways. It was admitted that Bell invented *a* speaking telephone. It was not admitted that Bell was the inventor of the first speaking telephone. A distinction was made between the telephone invented by Reis in 1861 and the telephone invented by Bell in 1876 as being unlike in principle though having the same function, namely, to transmit speech. It was affirmed at the outset that Bell was not the inventor of the first speaking telephone, but that Reis invented one long before, and this was reiterated time and again in the case. Judge Gray knew this, and he carefully framed his statement so as to convey the impression that admissions had been made which had not been made, and yet if the sentence was carefully scrutinized, it would be found to be rhetorically correct—a case of trifling with the language which one would not look for in a United States judge. The whole trouble lies in the use of the word *first*. It was admitted that Bell was the first inventor of (a particular kind of) a telephone. It was emphatically denied that Bell was the inventor of the first speaking telephone, and it was asserted that Reis invented a speaking telephone fifteen years before.

A. E. DOLBEAR.

College Hill, Mass., Dec. 1, 1885.

The Axolotl.

To the Editor of the Scientific American:

In the SCIENTIFIC AMERICAN, July 5, 1884, is an article on "The Mexican Axolotl," with an illustration from specimens then under the observation of Prof. H. J. Rice. I obtained five specimens from a creek here and placed them in my aquarium. They were two inches long, with branched gills, four toes on front feet, and five toes on hind legs; the feet being very nearly transparent, as also was the tail. In three weeks, with water at an equal temperature of 66°, they changed from a bright yellowish-brown to an almost black color; sexual organs becoming very prominent and large, and the animals having an extraordinary appetite, gulping down everything they could swallow, and sometimes tearing off and swallowing a leg from each other, or a piece of tail, all of which grew on to the mutilated animal in perfect form again inside of two weeks. The animals had no anus, but after digesting their food it was rolled into a ball into their stomachs, and ejected from the mouth. I fed them house flies, which they preferred above any other food. In these three weeks they attained a length of 4½ inches, and the branched gills had changed to prongs, having a slight backward curve, and having a solid appearance.

In four weeks, the pronged gills had turned under just behind the head, having the appearance of two black knobs, and outer skin of tail beginning to come off in thin, gauzy strips, polluting the water, so that I changed it regularly three times a week thereafter.

In five weeks, gills had turned down completely, and had become part of the head, which began to have a flattened appearance; outer skin of tail and body being cast off in larger quantities; two nostrils appearing over the mouth, like fine pin points, the head being capable of moving up and down; the eyes protruding, and being capable of being moved independently of each other, and the animal coming up more often for air, and sexual organs growing smaller.

In six weeks, all the females have changed to land animals, and males beginning to change. Nostrils protruding, eyes prominent and bright, sexual organs almost disappeared, and animals having a decided preference to dry land instead of water. Loss of appetite noticed in all of them, and their walk is a peculiar staggering gate, as though they had not attained sufficient strength for this exertion, and loved to lie by the hour, as though asleep, on the dry stones above the aquarium.

Seventh week: all the axolotls transformed into perfect *salamanders;* bright yellow spots covering them entirely; a quick, running movement, performed now with ease; sexual organs appearing almost indistinct, and the animals becoming amphibians. From the time when they transformed until they became true salamanders, they took little or no nourishment whatever.

F. E. JEROME.

Russell, Kansas.

The Red Skies Continue.

To the Editor of the Scientific American:

Very little, if anything, has been said in the past year about the phenomenon of the red sky; and yet the red skies continue, and in 1885 we have quite as fine effects as in 1883.

In the last of August, 1883, there was a large volcanic eruption at the island of Java. It was undoubtedly the grandest affair of the kind known to the modern world, and was said to have thrown ashes to the height of 3,000 feet.

People unfamiliar with the revelations of the weather map at once thought that they saw a connection between this eruption and the beautiful red skies; while others, who could not quite believe that this delicate coloring was due to volcanic dust, thought that it must in some manner be due to dust particles, so advanced the idea of meteoric or "cosmical" dust; that is, they would seem to carry the idea that such a phenomenon could only be caused by dust.

Why should it be implied that such theories as these are not in harmony with the weather map, and what has the weather map to do with the subject?

First, the map shows the meteorological conditions of the earth, from which we learn all about the movements of the atmosphere, and how impossible it would be for dust to travel around the world, even though it had the property of giving to the sky a certain coloring. Next, it shows us the atmospheric conditions under which we always have a red sky. Those conditions given, and a "red sky" is as certain as that we will have ice when the thermometer falls below 32°. A subject supported by such positive and negative evidence would seem to be all-sufficient to convince any reasonable person.

On the one side the evidence of impossibility, as impossible as that water would run up hill; on the other, that certain conditions will produce certain effects.

As shown before in articles on this subject, it would be impossible for the dust from Java to reach the United States. People unfamiliar with the weather map may not be able to see and understand the full force of the argument, yet the map is patent to all, and all may see it and learn from it the movements of the atmosphere, and with a little care and attention understand how such a cause cannot produce such an effect, and what conditions prevail when such a phenomenon does occur.

In meteorology we have the two factors high and low barometer, technically called "high" and "low." These move on general lines from the west toward the east. The areas of "low" move in irregular belts, evidently around the world. They are continually appearing in the west and disappearing in the east. These "lows" are from 1,000 to 2,000 miles on centers, with a "high" between. On the basis of 2,000 miles on centers, which would be a very low average, there would be fully six centers in one belt in the half circumference of the globe, to say nothing of the additional centers by the multiplicity of belts of "lows."

These "lows" in the atmosphere are like so many valleys in the topography of the earth. The wind is toward them from all points of the compass, whereby the atmosphere from all around, within its influence, is drawn to a common center. By this arrangement the clouds are carried to the place, more or less near the center "low," where the precipitation occurs.

The clouds move at a height of at least 23,000 feet, showing movement of atmosphere at least that high, which would preclude anything like dust that was only thrown 3,000 feet in air from passing over and beyond its influence in a contrary direction. The "low" nearest to Java would catch this dust, and it would be precipitated to the earth within a limit of 2,000 miles. If perchance some little should get beyond one center, and run the gantlet of one "low," it would have to come in contact with another, another, and another; so we see that it would have little opportunity to run the gantlet of from six to a dozen, or perhaps more, and have about as much of a chance of reaching the United States as the waters of the Pacific would of flowing across the area of the United States into the Atlantic.

In the absence of any more than the few meteors which are occasionally seen in the heavens, and the height at which the delicate coloring takes place, the meteoric dust theory is as unreasonable as the volcanic dust idea.

I do not care, in this short article, to repeat all the argument in favor of the vapor theory; enough to say that these red skies proceed from a certain condition of the atmosphere, and that they may as readily be foretold as a "local storm" or tornado. We only have to consult the map, and familiarize ourselves with the conditions under which these effects of red and pink skies take place. Given a south "high" and a north "low" we will have the phenomenon almost every time. Why not every time? For the simple reason that the sky is not always clear, even with a "high"; but only with a "high" do we have a clear sky. At "high" we have the minimum of moisture, the delicate suspended vapor, which in combination with the north "low," to give the necessary amount of heat, produces the red sky.

These conditions being given, a red sky is as certain as a "local" with a north or far away "low," or a tornado with a "low" (in the United States) traveling northward toward another "low" far to the north.

I. P. NOYES.

Washington, D. C., October 26, 1885.

The Death of William H. Vanderbilt.

Mr. Wm. H. Vanderbilt died suddenly at his home in New York city on the afternoon of Dec. 9th. He was stricken with apoplexy while conversing with Mr. Robert Garrett, President of the Baltimore & Ohio Railroad, and expired instantly. The funeral took place from St. Bartholomew's Protestant Episcopal Church, of which he had long been a member. The body was temporarily interred in the family tomb on Staten Island, but will eventually be removed to the new mausoleum now under course of construction. Mr. Vanderbilt was undoubtedly the richest man in the world. His estate is estimated at two hundred million dollars. At such a time, however, it is more pleasant to recall his benefactions during life. He gave largely to the Medical College in New York and to Vanderbilt University, at Nashville, Tenn. It is to his generosity that we owe the transfer of the Obelisk to Central Park. In spite of his great wealth, amounting to probably not less than $22,000 a day, Mr. Vanderbilt was very simple in his habits, and found his greatest pleasures within his family.

Good for Freckles.

Dr. E. Morse in the *New Eng. Med. Monthly* says:

I have found the following very good for the removal of freckles:

R.	Sulphocarbolate of lime	ʒ ij.
	Glycerine,	
	Rose water, aa	ʒ xxv.
	Alcohol	ʒ v.

Mix. Wash the skin twice in twenty-four hours, letting it remain damp with the lotion for half an hour. It has proved itself most excellent where all other remedies had failed.

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IMPROVED SAND BLAST MACHINE.

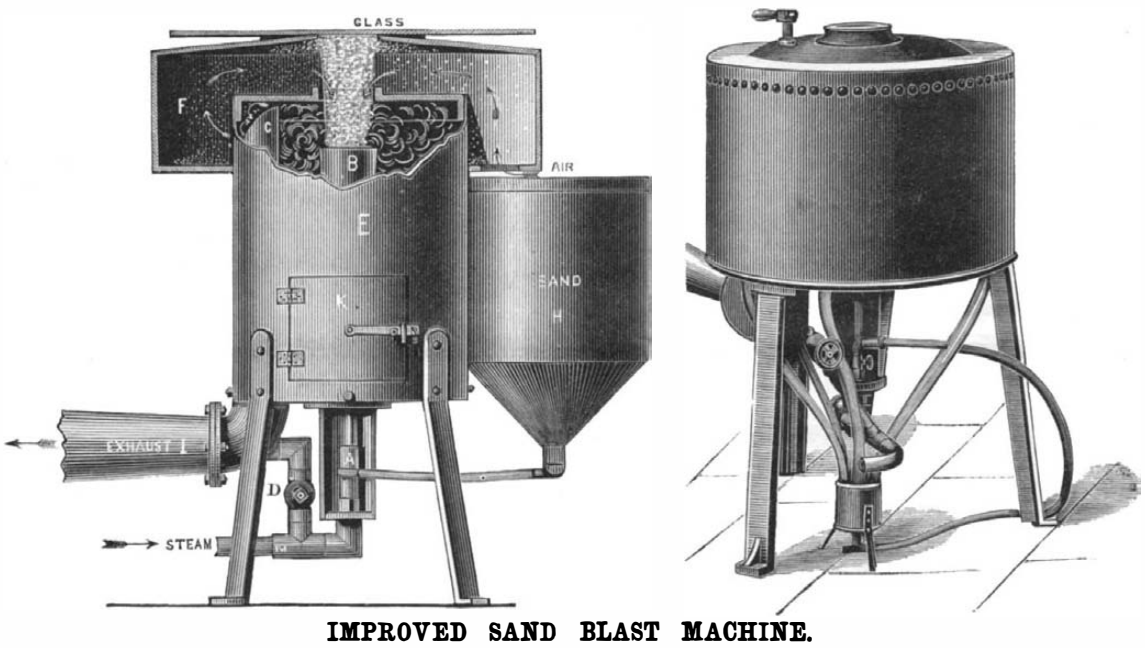
We give an illustration of an improved form of the Tilghman sand blast as designed by Mr. Mathewson, of London, in which the difficulties occasioned by the use of steam for driving the sand are in great measure overcome. Heretofore, by the sand blast process of cutting, boring, frosting, or ornamenting stone, metal, or glass, the use of steam as the propelling force is in most cases impracticable, owing to the condensation of the latter and the difficulty of manipulating the articles. Further, the stencil plates are liable to become clogged by the damp sand, and glass articles in particular are in danger of being broken from the heat of the condensed steam; the cheapest and most manageable substances are precluded from being used as patterns; and the waste sand must be dried each time it has been used. These objections have been overcome by Mr. Mathewson, by the use of an exhaust arrangement, which draws off all the steam before it reaches the article under operation, and at the same time dries the sand. The method of accomplishing this will be readily understood from the illustrations. The steam enters by the pipe, M, but by opening a cock, D, a small portion is deflected and enters the exhaust pipe, I, which terminates near the top of the chamber, E, the upper portion of the pipe being shown at C. This rush of steam produces a strong current of air in the direction shown by the arrows, which effectually dries the sand, and carries along with it all the steam and moisture through the exhaust pipe to the chimney. We have witnessed this apparatus at work, and can testify to the genuineness of the claims of the patentee. Sand blasting appears to be coming to the front more and more every year, and is now used for a great variety of purposes. We have seen sheet steel which was rolled in the ordinary manner, and then sand-blasted to remove the scale, and afterward heated and rolled again, which had thereby received a very high polish, and a surface capable of withstanding the effects of the weather. This system offers itself as a ready and effectual means of cleaning the surfaces of metal of all kinds from scale, etc., which is now effected by the use of acids, which penetrate metals and reduce their value for many purposes; also for incising ornaments with astonishing rapidity in granite and other stone.

An improved form of this apparatus is also shown. In this case, the sand after use falls into the hopper, and thence finds its way again through the four India rubber tubes shown into the small box below, from whence it is again ejected by the steam, and so on. The latest machines have a foot lever, by depressing which the operator makes the connection between the sand and the steam jet, but immediately the foot is removed from the lever this connection is broken, and the sand of course ceases to pass. We may also mention that a deflector is arranged in the interior of the case, which, by means of the handle shown on the top, can be brought in the course of the sand, and so deflect it, while the operator is adjusting the work. The velocity of the sand, of course, depends on the pressure of steam used, and so can be regulated to any desired degree. With steam at 60 pounds per square inch, and coarse sand, a hole 2 inches in diameter can be perforated through plate glass half an inch thick in two minutes.—*Mechanical World.*

THE CYCLOIDOTROPE.

BY GEO. M. HOPKINS.

The new and very pleasing and interesting lantern slide shown in the annexed engraving is of English origin. The maker's name is unknown to us, nevertheless we give him credit for having produced a simple device capable of illustrating on a large scale the intricate operation of engine engraving.



IMPROVED SAND BLAST MACHINE.

The figures shown in the smaller engraving were photo-engraved directly from plates, traced in the apparatus. They show some of the simpler forms of curves. By changing the adjustment of the tracing needle or the arms which support and guide it, an infinite variety of figures may be produced.

The ring, which revolves on the plate, is recessed around its inner edge, and lined with soft rubber for

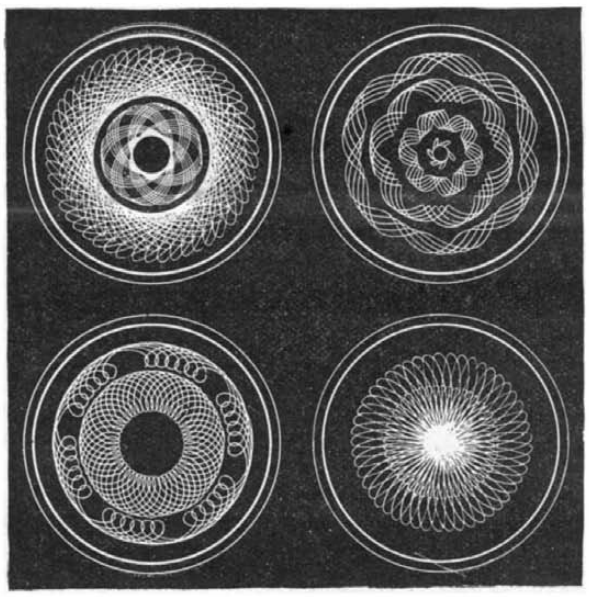


Fig. 2.—TRACINGS PRODUCED BY THE CYCLOIDOTROPE.

the reception of the glass disk, upon which the tracing is to be made. The glass is held in place by the pressure of two springs carrying rollers which bear upon the face of the glass at diametrically opposite points.

The face of the ring has a toothed rim, which is engaged by a small pinion on the crank shaft, and the periphery of the ring is provided with 202 spur teeth, which engage a pinion having 33 teeth and turning on a stud projecting from the base plate.

The spur pinion carries an adjustable crank, the pin of which turns in the crank arm, and is apertured transversely to receive the tracing rod, which may be clamped therein by the thumb screw.

The tracing rod passes through a stud arranged to turn in the end of the movable arm pivoted to the base plate. The tracing rod is hollow, and upon the end which projects over the toothed ring it carries a curved spring, provided at its extremity with a steel tracing point. A wire passing through the hollow tracing rod engages the under side of the curved spring, and lifts the point from the glass.

The glass is prepared for tracing by smoking it over a candle, lamp, or gas jet, or, better, by coating it with collodion to which some aniline has been added to give it the desired tint.

The glass having been secured in place in the toothed ring in the manner described, the tracing point is let down upon the glass by drawing out the wire in the hollow tracing rod. The toothed ring is then rotated by means of the crank, when a cycloidal curve will be traced on the glass. By continued rotation the curves will be duplicated; and as the number of teeth in the periphery of the ring is not an exact multiple of the number of teeth in the pinion, the ring will, by the differential movement, continually fall behind the movements of the pinion and tracer carried by the crank on the pinion, so that a small space is left between the lines of successive series. By continuing the operation the lines will intersect, until finally a beautiful, symmetrical network of lines will be formed.

By clamping the tracing rod in the crank pin, an approximately true cycloid curve will be formed; and by clamping the tracing rod in the stud projecting from the adjustable arm, and allowing the crank pin to slide on the rod, curves of another kind will be formed. Moving the arm on its pivot makes another change, and the figure is still further modified by changing the working field of the point from one edge of the glass disk to the other.

To render the tracing still more intricate, opposite sides of the glass disk may be coated with collodion differently colored. For example, red may be used on one side and blue on the other. The color of the ground when projected on the screen will then be purple. When the tracing is done on the blue side, red lines will appear on a purple ground; and when the tracing is made on the red side, blue lines will appear on the purple ground; and where the tracings of opposite sides of the glass cross each other, the lines will, of course, be white.

Besides the remarkable effects secured by the use of two colors, the thickness of the glass which intervenes between the two tracings produces a curious optical illusion on the screen. The tracing last made, if in focus, appears to stand out several inches from the screen, and seems to float in the air.

Another interesting optical illusion is noticed when, after rather rapid rotation, the disk is stopped. By the bias of the optic nerve the figures appear to turn backward.

The disks traced in this apparatus produce striking effects when used in a chromatrope in place of the ordinary painted disks.

This device has been exhibited at some of the places of amusement in this city for some weeks past. It universally creates among the spectators a murmur of satisfaction and surprise.

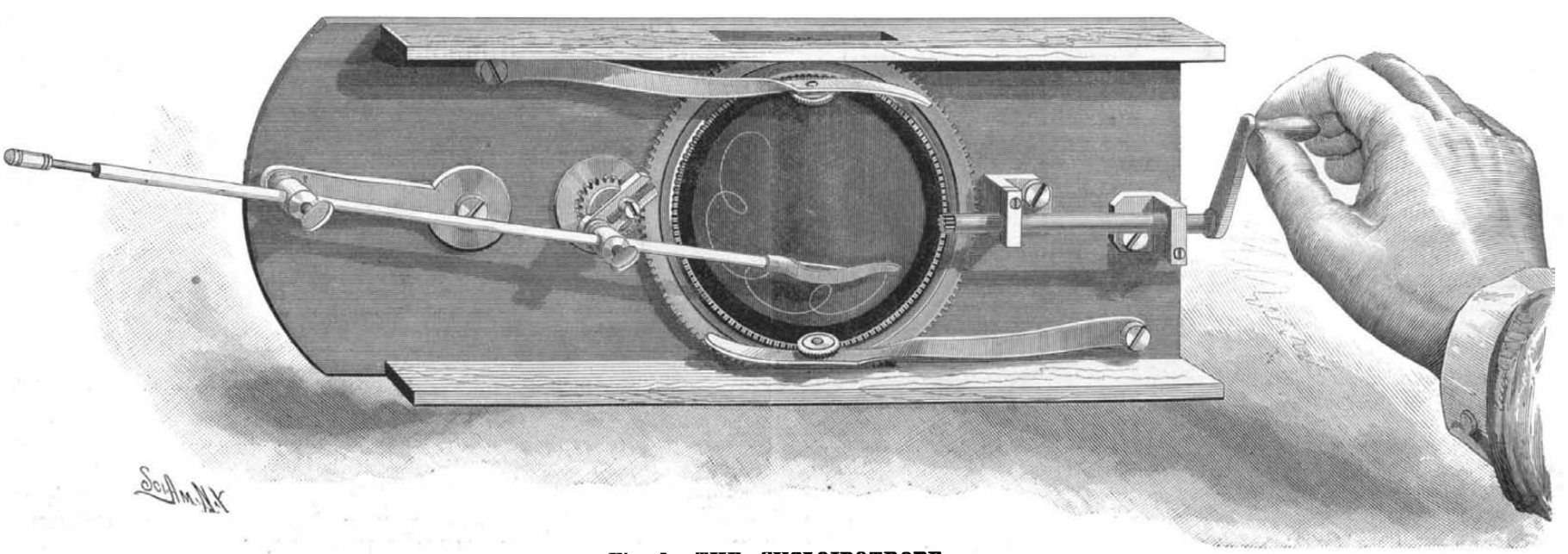


Fig. 1.—THE CYCLOIDOTROPE.

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M. PASTEUR'S AMERICAN PATIENTS.

Among the passengers on board the French steamship Canada, which left New York for Havre on the 9th inst., were four children from Newark, N. J., who were bitten by a mad dog on the 2d. The animal was foaming at the mouth, and evidently suffering from rabies. Its singular behavior attracted attention, and the alarming cry of "Mad dog!" drove all grown people from its path. The children and dogs were less fortunate. After biting several dogs, the animal attacked a number of children, knocking some of them down and biting them savagely on the arm, face, and leg. The brute was finally shot, but not until it had bitten six children in all—William Lane, thirteen years old; Hattie Frick, ten; George Childs, six; Austin Fitzgerald, ten; Edward Ryan, eight; and Patrick J. Reynolds, nine.

The injured children were all taken to the office of Dr. Osborn, where their wounds were cauterized. Dr. O'Gorman attended them, and a movement was started at once to send them to Paris. In answer to the request for treatment, M. Pasteur sent a cablegram: "If you apprehend danger, send the children immediately." As the parents are all in moderate circumstances, the expense of such a journey has been met by a most generous subscription. The Newark storekeepers have vied with each other in adding to the comfort of the little travelers during their voyage. In addition to the outfit, over a thousand dollars has been subscribed. The four children who have been sent, Wm. Lane, Austin Fitzgerald, Eddie Ryan, and Patrick Reynolds, are in charge of Dr. F. S. Billings, of the New York Polyclinic, who is an enthusiast in researches into this class of diseases. Mrs. Ryan, the mother of one of the boys, also accompanied them. As she speaks French, she promises to be a useful nurse. The children will probably reach Paris a few days before Christmas, and will remain under treatment about a fortnight. M. Pasteur expresses no apprehension of unfavorable developments during the voyage, and is very confident that he will be able to remove them from any danger of hydrophobia. It is unfortunate that all the children could not have been sent to him.

Besides the humane sympathy which their condition has excited, there is a strong scientific interest attached to these cases.

About 50 per cent of the people who are bitten by mad dogs, and whose wounds are cauterized, develop hydrophobia. The dogs bitten by the rabid beast have been secured, and their subsequent behavior will probably add another proof to a case of genuine rabies in the aggressor.

The operation of inoculation consists simply in injecting virus under the skin by means of a hypodermic syringe. Ordinarily, it produces no illness or unpleasant results of any kind. In our engraving, which is taken from *L'Illustration*, we show the process of treatment as applied in the case of a young shepherd boy who was recently treated by M. Pasteur.

The first step in the preparation of the virus used in this operation is the inoculation of a rabbit with a fragment of tissue taken from the spine of a rabid dog. The hydrophobia microbes contained in this tissue, by introduction beneath the skin of the animal or preferably into its brain, penetrate the entire system, and communicate the disease. The animal becomes mad. The incubation of the poison occupies fifteen days. As soon as death occurs, a portion of the spinal marrow of this diseased rabbit is introduced into the system of a second rabbit; from the second rabbit, matter is taken with which a third rabbit is inoculated; and the process is continued until sixty animals in all have been treated. The power of the hydrophobia virus increases with each inoculation, so that the last incubation of the sixty operations occupies but seven days. On the other hand, the power of the virus is diminished by dried air, so that different degrees of strength are obtained by keeping the spinal marrow of the inoculated rabbits in bottles of dried air. In beginning his treatment, therefore, M. Pasteur inoculated the shepherd boy with old tissue, the strength of which had been attenuated by the action of the dry air.

Gradually the strength of the virus was increased, until at the last injection, at the end of about a fortnight, the tissue employed had been bottled only two days. The period of incubation of the last inoculation did not exceed a week, but the system of the patient had been brought to such a condition that it could receive such powerful virus without injury. This treatment not only prevented the development of rabies in the patient, but as M. Pasteur assured him, gave ample protection against the attacks of any other mad dogs for a year at least.

In almost all cases, M. Pasteur's treatment has so far been successful. He has recently inoculated three children who came to him from Algeria, two months after having been bitten. They have now returned to their homes, and are in perfect health, though the death of one of their comrades before they started for Paris gave unmistakable evidence that the dog was rabid. It may, of course, be possible that the virus of the mad dog did not reach the two children who are living. There are at present no less than sixty-two persons under treatment by M. Pasteur, for hydrophobia. One patient, a young girl who was bitten by a mad dog and subsequently inoculated, has died of rabies; but as thirty-six days elapsed before she was operated upon, the period of incubation had expired, and the treatment came too late. Though this case shows the necessity of prompt action, it does not detract from the value of the system; although an unbeliever might say, perhaps, it was the treatment that caused the death.

The introduction of M. Pasteur's system in America would seem to be desirable. It would involve the establishment of rabbit farms in various parts of the country, where the animals would be kept constantly inoculated with the disease. It is a suggestion not unworthy the attention of the present administration that government shall lend its assistance in the matter.

M. PASTEUR'S TREATMENT FOR HYDROPHOBIA.

Jenner and Pasteur.

The case of the girl who was bitten by a mad dog and subsequently but unsuccessfully inoculated by Pasteur is fully reported in our dispatch by the Mackay-Bennett cable to-day. The failure to save this patient is no disparagement of Pasteur's treatment. He very satisfactorily explains that over six weeks had elapsed after being bitten before the girl was inoculated, and consequently the incubation of the disease had matured. There may be some delay in perfecting the new treatment of hydrophobia, but there is now every reason to be confident that it will eventually prove a great triumph of patient research.

No one who has read the history of Jenner's discovery, by which the terrors of smallpox were abated over all Europe ninety years ago, can fail to notice how it repeats itself in the work of Pasteur. The discoverer of vaccination met with opposition from those who denounced vaccination as a dangerous practice; but the severest trial he had to undergo was the advocacy of some rash men, one of whom, a doctor, before ever having even seen a case of cowpox, published a pamphlet on the subject and put himself forward as the chief leader in the cause of vaccination. The modest and real discoverer, after successfully inoculating a boy in 1796, had to wait nearly two years before he could make a second experiment. The success of his system and its general acceptance by the medical men were also imperiled at an early stage of Jenner's work by unskillful attempts to repeat his experiment. M. Pasteur has also already to bear the "faint praise" of critics, the ridicule of others, as well as the overzealous championship of ignorant friends.

These facts should be carefully noted by medical men in connection with M. Pasteur's hydrophobia researches. It is desirable that his discovery and the practical means of applying it should for a while be only in the hands of able professional men, who will not bring the new remedy into disrepute by unskillful practice. It is equally important that the world should suspend judgment on the merits of the discovery—avoiding both hasty criticism and overenthusiastic advocacy of the cure—until Pasteur has had ample time and opportunity to perfect his system.—*N. Y. Herald.*

Molecular Weight of Liquid Water.

Thomsen has called attention to the fact that the conclusion reached by Raoult in his researches n the freezing point of saline solutions, that water possesses, in the condition of liquid, twice the molecular weight which it has in the condition of vapor, coincides with the conclusion to which he himself had come from his investigations on the constitution of hydrated salts. In his thermo-chemical researches, Thomsen says: A glance at the table of heat of hydration of hydrated salts shows that the water molecules enter often in pairs with the same heat change; a fact explicable either by supposing that the molecules of water are symmetrically placed in the molecule of the salt, or, and perhaps more probably, that the molecular weight of liquid water is twice that of water vapor. The similarity of these conclusions, from widely different fields of investigation, is noteworthy.—*Ber. Berl. Chem. Ges.*, xviii., 1088, April, 1885; *G. F. B., Amer. Jour.*

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Genesis of a Car Wheel.

It is estimated that there are ten million car wheels whirling over this country at the present moment, conveying millions of passengers and more millions of tons of freight to and fro across the continent at an average speed of 25 miles an hour for passengers, and often 40 miles. How many of the hurrying multitude who trust their lives on the rail pause to consider the admirable mechanism by which these great results are accomplished? How many complex problems have been solved in the gradual evolution of the old time stage coach into the modern iron horse and his train?

Take, for example, a car wheel, one of the simplest parts of a railway train; it is merely a round piece of iron, and, as we generally see it, covered with dirt and grease, having nothing attractive or ornamental in its appearance, and seemingly gross, in its construction; yet that smaller and more valuable disk, known as "Uncle Sam's" double eagle, which issues from the mint, glittering like a mirror, does not involve in its manufacture more intricate and, in some respects, more delicate manipulation than this same gross car wheel.

The most important difference between a car wheel and an ordinary machine or apparatus made of cast iron is the fact that the "tread" of the wheel, viz., that part which runs on the rail, is quite different in character from the "plate," or main body, though cast from the same metal in one pouring. The tread or rim is actually harder than the finest steel, thus enabling it to resist not only the wear upon the steel rail, but the still more destructive grip of the brakes; and its average "life" is not far from 100,000 miles of service. The process by which the hardening of the tread is produced is called "chilling," and is somewhat analogous to the "tempering" of steel. A mould is made in sand from a wooden pattern, the moist sand is pressed by the moulder against both sides of the pattern with a hand rammer, and it is then sufficiently tenacious to enable the pattern to be carefully removed without destroying the mould. This "sand mould" is inclosed in a ring made of iron, called the "chill mould," whose internal face has been previously turned upon a lathe to form the tread and flange of the wheel, and numerous air passages, or vents, are made through the sand with a long needle to permit the gentle escape of highly explosive gases which are formed when the molten iron is running into the mould.

The stream of glowing fluid iron quickly fills the hollow space between the upper and lower sides of the sand mould, and running to the edge comes in contact with the iron ring or chill mould, and this, being a much better conductor of heat than the sand mould, chills the rim of the casting, not only congealing the iron instantly, but causing it to crystallize to a depth of about half an inch in beautiful parallel filaments, as white as silver and nearly as hard as diamond. The portion of the wheel forming the plate or sides cools more slowly, is not "chilled," and its texture is the same as that of ordinary cast iron. If the wheel is made of a mixture of iron which is too highly sensitive to the chilling influence, it will be too brittle for safety and too hard to permit of boring the hole in the hub into which the axle is to be fitted. If, on the other hand, the metal does not possess sufficient chilling property, the tread of the wheel is too soft, and soon becomes flattened, and then the wheel is useless. The margin between these extremes is very small, and it is the daily aim of the wheel maker to steer between this Scylla and Charybdis.

It must not be supposed that all irons possess this chilling property, for it is a comparatively rare one, and little is known, even among the most expert iron masters, of the causes which produce it. Very recently some light has been thrown upon the subject by the aid of chemical analysis, and scientific investigation will doubtless reveal still more clearly what is as yet but dimly seen. Pig iron is not a simple substance, but is in reality an alloy composed of at least half a dozen different elements, each one of which helps to stamp its character upon the metal. It has been found, for example, that the substance silicon, which is always present in pig iron, exerts an extraordinary influence upon its chilling power, and a variation of less than one per cent of silicon is sufficient to make or mar a car wheel; indeed, it has happened that an entire day's work of several hundred men has been spoiled by an excess of one-half of one per cent of this substance creeping undetected into the mixture. The method of analyzing the iron to ascertain the proportion of carbon, phosphorus, manganese, sulphur, and silicon which it contains is too complicated to admit of a general description; suffice it to say, that a few grains of a sample are reduced to fine powder, weighed upon an extremely sensitive balance, treated with acids and other "reagents," or tests, by which means each element is separated from its partners, and its weight ascertained. In a wheel foundry the iron is commonly melted in a large furnace called a cupola, capable of melting fifty or more tons a day. Anthracite coal is used, and a strong blast of air from a pumping engine creates an intense heat. As the iron melts, it collects in a pool at the bottom of the furnace, from which it is drawn into an immense ladle or caldron, sometimes holding fifteen or twenty tons; from this it flows into smaller ladles, holding just sufficient molten iron to make one large wheel.

Great skill is required in pouring the iron into the mould. It must be just the right temperature and it must be allowed to run into the mould with just the right force; otherwise a bad casting is the inevitable result. After the wheels are taken out from the moulds, they require to be thoroughly annealed, as they are subjected to an immense strain, due to the more rapid cooling of the chilled tread. For this purpose they are either put into pits previously heated, or buried in hot sand, where they are allowed to remain for several days. In this way the molecules of the metal gradually arrange themselves in new positions, and the strain is entirely removed. The sand which adheres to the wheels is then brushed off, and the wheel tested for strength by heavy blows with a sledge hammer, and for hardness on the tread by chipping with a highly tempered cold chisel; in this way any "soft spots" may be readily detected, and the wheel accordingly condemned. There are, in fact, no less than 27 distinct "diseases," so to speak, which a car wheel is liable to contract in the course of its manufacture, and it must pass a rigid inspection in the quarantine or "cleaning shop" before it receives the required guarantee of its maker that it is "free from all defects."

Finally, having obtained a clean bill of health from the inspector, the wheel passes to the machine shop, where the hub is bored out, the axle fitted in by hydraulic pressure (of 15 or 20 tons), and the wheel and its mate are ready to start out on their long journey. If they are well matched, they should roll along through their whole life without jarring, and, barring "accidents," will often travel 150,000 miles before becoming completely tired out.

The chilled cast iron car wheel is a purely American invention, and the method of annealing, which alone made this process practicable, was devised by a manufacturer in this city as long ago as 1847, since which time between one and two million wheels have been made in the works established by him, and have been shipped to all parts of the world where the shriek of the locomotive whistle has penetrated.—*Philadelphia Public Ledger.*

An Engineer's Observations.

Some young or incompetent old engineer, bothered over the working of his engine, may derive useful hints from the experience of a writer in the *Modern Miller*, who has evidently been considerably perplexed at times, but has had the wit to divine the cause and the skill to remedy the trouble his machines were causing him.

I remember once, he says, in a new mill with a new engine and a young engineer, after running a few days there began a terrible knocking about the engine, and for some time it was hard to locate it, but we finally did, in the yoke on the eccentric which worked the steam valve. The engineer and myself squinted around that for some time, until we concluded it was caused by the yoke not being true and having too much play, and that we would have to babbitt it to a fit. We hesitated to do it, however, and got an old engineer to come and take an observation. After watching a little while, he suggested the fault might be inside the steam chest. The engineer soon opened that, and found the cause of the trouble; the jam nut being loose on the end of the valve stem and striking against the end of the steam chest, caused the chucking at the eccentric. I have always made it a rule to remember all such incidents, as it is by such experiences we learn how to care for the machines in our charge.

A few years after, I was in charge of another mill, in another part of the country, and in this case also starting with a new mill. Here we had an engineer who for the time had a steam pump boiler feeder to run, and it soon began to cause trouble, and the crank pin broke off. It fell upon me to go to the city and get a new part, and I got it at the shop where the pump was made. The maker was surprised, and said he had never had one break before, and made me promise to find out the cause and write him. So when I returned, and the pump was again at work, I took occasion to observe it. It commenced knocking, and remembering the experience before related, I suggested to the engineer that he take it apart, and look for something striking the end of the cylinder, which he did; and, sure enough, there was a nut that needed turning up, which, being done, there was no more trouble with that pump. In the best and most careful shops there is liable to occur an oversight that may cause trouble. Every man in charge of machinery should use great care. Do not be too hasty in condemning machines; locate and remedy defects if possible; have patience and judgment. That's the way to be a good engineer.

It is often a very trivial thing which affects the working of a machine. An employer of mine once had an opportunity to buy a wheat cleaning machine at less than one-third the original cost, it having been used but a short time. We needed a new machine, and this was a good kind, of well known manufacture, and I advised him to buy it. He did so, and we soon had it in operation, and behold! it wasted wheat very much, and no adjustment of draught would remedy it. That revealed why it was disposed of so cheaply. As the adjusting of draught did not affect the waste of whole wheat, I decided at once that I must have a leak in the scouring case, a very simple matter to reason out. I took it apart, and found a place at the end of the scouring case where the leak occurred. This I remedied in a few minutes, and we then had a machine doing perfect work, and I felt as though I had enabled my employer to save over $200.

I remember where, in another mill, we set up on trial a new wheat cleaning machine, to which the manufacturer had but lately added a separator having a large vibrating sieve, which was attached by single nuts. These nuts kept getting loose and allowing things to come apart. It was a fault of construction which could be easily overcome by the manufacturers, and I wrote them describing explicitly the trouble, suggesting how to better construct the part, and offering to hold machine and apply any remedy they might provide. They replied that their machines had a wonderful reputation, and insinuated that we must be ignoramuses, and had insulted them. Of course that machine went back, and to-day they are heard of no more in the land. I observe that the machines that are put together in the strongest and most durable manner are the ones that stay the longest and win a profitable trade for the manufacturers. The phenomenal success of some machines is largely due to this fact.

The wood called "osage orange" in the North, and "bogart" in Texas, where it is indigenous, is hard, like lignum vitæ. It does not swell or shrink, is wonderfully durable, and would be an excellent wood for waterwheel steps, boxes for journals on slow shafts, keys, or for any use where a hard, nice finish is required. It lasts a lifetime in the form of shingles, posts, etc., in Texas.

I noticed an engineer the other day doctoring a belt to prevent its slipping by pouring grease on it and then fine resin to cover it all. If I had been his employer, I would have told him how to do better, and a repetition would have brought his walking papers. It costs a good deal to buy belts to be used that way, for they would be short lived. Good neatsfoot or castor oil applied to belts occasionally Saturday nights is good treatment, but such treatment as the above is very injurious to a belt.

I once observed, in a new mill nearing completion, a pair of gears in the upper story, where nothing but elevators and, perhaps, a wheat cleaner would ever be driven, that were heavier than the gears in the basement, that drove all the machinery except the burrs. I asked the superintending millwright the philosophy of that, and he said heavy gears ran steadier and easier than light gears. I do not believe this. While I believe gearing should be heavy enough to do its work without strain or unnecessary wear upon cogs, too heavy gearing is a detriment, and to have the heaviest gears in the upper story of the mill is reversing all the mechanical laws as applied to the transmission of power, and displays a millwright's ignorance.

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The Modern Foot.

In Greek statues, as is well known, the second toe of the foot is represented as longer than the great toe, while in the modern European foot the great toe is usually the longer. Albrecht states that in this respect the Greek foot is more quadrumanous than the modern. The second toe is also represented in antique statues as being further separated from the great toe than is seen at the present time. This might be regarded as another evidence of quadrumanous character, but it has also been suggested, and not without reason, that it is simply the result of wearing the sandal strap. In the modern foot, on the other hand, the reduction in the size of the smaller toe is ascribed to the influence of shoes.

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Disinfectants.

The annual meeting of the Public Health Association was opened in Washington, Dec. 8th. President, Dr. James E. Reeves, of Wheeling, W. Va. Various addresses were made and papers read. The Committee on Disinfectants consisted of Drs. George M. Sternberg, U. S. A., Joseph H. Raymond, Brooklyn, Charles Smart, U. S. A., Victor C. Vaughn, Michigan, A. R. Leeds, New Jersey, W. H. Watkins, New Orleans, and George H. Rohe, Baltimore. Their report was presented. The following are their conclusions:

The most useful agents for the destruction of spore-containing infectious material are:

1. *Fire.* Complete destruction by burning.
2. *Steam under pressure.* 110° C. (230° F.) for ten minutes.
3. *Boiling in water* for one hour.*
4. *Chloride of lime.*† A 4% solution.
5. *Mercuric chloride.* A solution of 1 : 500.

For the destruction of infectious material which owes its infecting power to the presence of micro-organisms *not containing spores,* the committee recommends:

1. *Fire.* Complete destruction by burning.
2. *Boiling water* half an hour.
3. *Dry heat.* 110° C. (230° Fahr.) for two hours.
4. *Chloride of lime.*† 1 to 4% solution.
5. *Solution of chlorinated soda.*‡ 5 to 20% solution.
6. *Mercuric chloride.* A solution of 1 : 1,000 to 1 : 4,000.
7. *Sulphur dioxide.* Exposure for 12 hours to an atmosphere containing at least 4 volumes per cent of this gas, preferably in presence of moisture.§
8. *Carbolic acid.* 2 to 5% solution.
9. *Sulphate of copper.* 2 to 5% solution.
10. *Chloride of zinc.* 4 to 10% solution.

The committee would make the following recommendations with reference to the practical application of these agents for disinfecting purposes:

FOR EXCRETA.

(*a.*) In the sick room:

For spore-containing material:

1. Chloride of lime in solution, 4%.
2. Mercuric chloride in solution, 1 : 500. ‖

In the absence of spores:

3. Carbolic acid in solution, 5%.
4. Sulphate of copper in solution, 5%.
5. Chloride of zinc in solution, 10 %.

(*b.*) In privy vaults:

Mercuric chloride in solution, 1 : 500.*

(*c.*) For the disinfection and deodorization of the surface of masses of organic material in privy vaults, etc.:

Chloride of lime in powder.†

FOR CLOTHING, BEDDING, ETC.

(*a.*) Soiled underclothing, bed linen, etc.:

1. Destruction by fire, if of little value.
2. Boiling for at least half an hour.
3. Immersion in a solution of mercuric chloride of the strength of 1 : 2,000 for four hours.‡
4. Immersion in a two per cent solution of carbolic acid for four hours.

(*b.*) Outer garments of wool or silk, and similar articles, which would be injured by immersion in boiling water or in a disinfecting solution:

1. Exposure to dry heat at a temperature of 110° C. (230° Fahr.) for two hours.
2. Fumigation with sulphurous acid gas for at least twelve hours, the clothing being freely exposed, and the gas present in the disinfection chamber in the proportion of four volumes per cent.

(*c.*) Mattresses and blankets soiled by the discharges of the sick:

1. Destruction by fire.
2. Exposure to superheated steam—25 pounds pressure—for one hour. (Mattresses to have the cover removed or freely opened.)
3. Immersion in boiling water for one hour.
4. Immersion in the blue solution (mercuric chloride and sulphate of copper), two fluid ounces to the gallon of water.

FURNITURE AND ARTICLES OF WOOD, LEATHER, AND PORCELAIN.§

Washing several times repeated with:

1. Solution of mercuric chloride 1: 1000. (The blue solution, four ounces to the gallon of water, may be used.)
2. Solution of chloride of lime 1 per cent.
3. Solution of carbolic acid, 2 per cent.

FOR THE PERSON.

The hands and general surface of the body of attendants, of the sick, and of convalescents at the time of their discharge from hospital:

1. Solution of chlorinated soda diluted with nine parts of water (1 : 10).
2. Carbolic acid, 2 per cent solution.
3. Mercuric chloride, 1 : 1,000; recommended only for the hands, or for washing away infectious material from a limited area, not as a bath for the entire surface of the body.

FOR THE DEAD.

Envelop the body in a sheet thoroughly saturated with:

1. Chloride of lime in solution, 4 per cent.
2. Mercuric chloride in solution, 1 : 500.
3. Carbolic acid in solution, 5 per cent.

FOR THE SICK ROOM AND HOSPITAL WARDS.

(*a.*) While occupied, wash all surfaces with:

1. Mercuric chloride in solution, 1 : 1000. (The blue solution containing sulphate of copper may be used.)
2. Chloride of lime in solution, 1 per cent.
3. Carbolic acid in solution, 2 per cent.

(*b.*) When vacated:

Fumigate with sulphur dioxide for 12 hours, burning 3 pounds of sulphur for every 1,000 cubic feet of air space in the room; then wash all surfaces with one of the above mentioned disinfecting solutions, and afterward with soap and hot water; finally throw open doors and windows, and ventilate freely.

FOR MERCHANDISE AND THE MAILS. ‖

The disinfection of merchandise and of the mails will only be required under exceptional circumstances; free aeration will usually be sufficient. If disinfection seems necessary, fumigation with sulphur dioxide, as recommended for woolen clothing, etc., will be the only practicable method of accomplishing it.

RAGS.

(*a.*) Rags which have been used for wiping away infectious discharges should at once be burned.

(*b.*) Rags collected for the paper makers during the prevalence of an epidemic should be disinfected before they are compressed in bales, by:

1. Exposure to superheated steam (25 pounds pressure) for ten minutes.
2. Immersion in boiling water for half an hour.

(*c.*) Rags in bales can only be disinfected by injecting superheated steam (50 pounds pressure) into the interior of the bale. The apparatus used must insure the penetration of the steam to every portion of the bale.

SHIPS.

(*a.*) Infected ships at sea should be washed in every accessible place, and especially the localities occupied by the sick, with:

1. Solution of mercuric chloride 1 : 1,000 (the blue solution heretofore recommended may be used).
2. Solution of chloride of lime, 1 per cent.
3. Solution of carbolic acid, 2 per cent.

The bilge should be disinfected by the liberal use of a strong solution of mercuric chloride (the concentrated solution—" blue solution "—of this salt with cupric sulphate may be used).

(*b.*) Upon arrival at a quarantine station, an infected ship should at once be fumigated with sulphurous acid gas, using three pounds of sulphur for every 1,000 cubic feet of air space; the cargo should then be discharged on lighters; a liberal supply of the concentrated solution of mercuric chloride (4 ounces to the gallon) should be thrown into the bilge, and at the end of twenty-four hours the bilge water should be pumped out and replaced with pure sea water; this should be repeated. A second fumigation after the removal of the cargo is to be recommended; all accessible surfaces should be washed with one of the disinfecting solutions heretofore recommended, and subsequently with soap and hot water.

* This temperature does not destroy the spores of *B. subtilis* in the time mentioned, but is effective for the destruction of the spores of the anthrax bacillus and of all known pathogenic organisms.

† Should contain at least 25 per cent of available chlorine.

‡ Should contain at least 3 per cent of available chlorine.

§ This will require the combustion of between 3 and 4 pounds of sulphur for every 1,000 cubic feet of air space.

‖ The addition of an equal quantity of potassium permanganate as a deodorant, and to give color to the solution, is to be recommended (*Standard Solution* No. 2).

* A concentrated solution containing four ounces of mercuric chloride and one pound of cupric sulphate to the gallon of water is recommended as a *standard solution.* Eight ounces of this solution to the gallon of water will give a diluted solution for the disinfection of excreta, containing about 1: 500 of mercuric chloride and 1 : 125 of cupric sulphate.

† For this purpose the chloride of lime may be diluted with plaster of Paris or with clean, well dried sand, in the proportion of one part to nine.

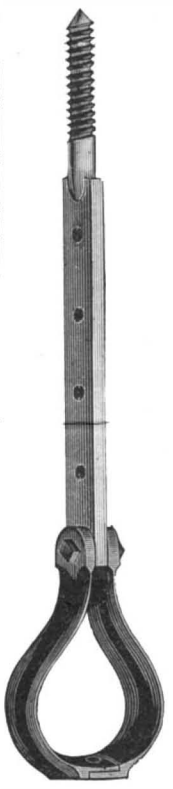
‡ The blue solution containing sulphate of copper, diluted by adding two ounces of the concentrated solution to a gallon of water, may be used for this purpose.

§ For articles of metal use Solution No. 3.

‖ In order to secure penetration of the envelope by the sulphur dioxide, all mail matter should be perforated by a cutting stamp before fumigating.

BLAKE'S "IMPROVED 1884" PIPE HANGER.

The annexed engraving presents a new and novel invention in the line of an adjustable pipe hanger.



The stirrup or ring is made in two parts, the lower end of one half having a pin fitting a corresponding hole in other half of ring. This is one of the essential features of the hanger, as it may be placed on or removed from the pipe when in position; the upper parts of each half of stirrup are held together by a bolt passing through and holding in position the lag screw, which is 13 inches long, and has on its flat portion a number of holes punched to allow for adjustment of pitch lines. To meet the many requirements of the trade, the manufacturers have added a number of combinations, including adjustable pieces and clamps for iron beams, also improved link pieces and lag screws, to suit cases where hangers are required of an extra length, the addition being made by ordinary gas pipe.

The use of this hanger, in place of the many crude and expensive blacksmith jobs and chain attachments so often resorted to, will prevent disastrous breakages of steam and water pipes, and will obviate the disagreeable knocking in steam pipes caused often by improper hanging and pitch lines.

Further information may be obtained from Messrs. Jenkins Bros., of 71 John Street, New York city, and 79 Kilby Street, Boston, Mass.

Floating Suits.

Buoyant clothing has been devised by a Londoner, and seems to be attracting some attention in that metropolis. Threads of cork are interwoven with cotton, silk, or woolen, machinery which slices the cork to the required thinness forming part of the invention. From these new materials clothes of ordinary appearance are constructed which bear up the wearer when committed unexpectedly to the water. The worth of the new fabrics was thoroughly tested by throwing three persons clothed in them from the end of a pier. They floated as easily as if incased in cork jackets. It is said that they remained in the water over an hour without discomfort. The possibilities of fireproof apparel are next in order.

Mechanical Glass Blowing.

Messrs. Appert have devised a process, in their factory at Clichy, in which they use air stored under great pressure, so as to dispense altogether with the necessity of blowing by the mouth. Glass blowers are peculiarly susceptible to various disorders, such as diseases of the lips and cheeks, and predisposition to tumors and rupture. These affections are the more serious because boys are often employed when the system is weakened by rapid growth. The high temperature and dry atmosphere increase the unfavorable hygienic conditions. The new process entirely suppresses blowing by boys, and, with rare exceptions, by adults also. The manufacture of glassware is thus ameliorated by rapidity of execution, as well as by the perfection and the large size of the pieces which are produced.

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ENGINEERING INVENTIONS.

A car coupling has been patented by Mr. George C. Thompson, of Darien, Ga. The under side of the mouth of the drawhead is curved and extended forward in a straight line with a mortise and slot, and the car coupling hook is pivotally supported, cords running in guides allowing of the coupling hook being elevated and the link released by a person on either side or the top of the car.

A suspension railway and car hanger has been patented by Mr. John A. Enos, of Peabody, Mass. It is designed to sustain a street passenger car from a point above its center of gravity, and yet allow the car to be close enough to the ground for passengers to get on or off, and consists of a novel construction of hanger track, with means for making the travel smooth and enable the car easily to climb grades. The same inventor has likewise patented a railway car adapted for this service, and a truck for elevated cars, both so constructed as to withstand the peculiar strains of this method of supporting the car.

AGRICULTURAL INVENTIONS.

A grain binder has been patented by Mr. David N. Green, of Commercial Point, O. This invention covers a novel construction and arrangement of parts for an improved grain binder especially designed for use with the Appleby grain binding harvesters, but also applicable to other harvesters.

A potato digger has been patented by Mr. Henry H. Lovejoy, of Cambridge, N. Y. Its construction is such that as the machine is drawn forward plows throw the weeds and soil into the furrows, and a digging hoe passes beneath the potatoes, fingers separating the potatoes from the soil and depositing the potatoes on the top of the soil ready to be gathered.

A cultivator and harrow has been patented by Mr. Dalton Walls, of Appleton City, Wis. This invention covers a novel construction and combination of parts so the machine can be readily guided and controlled by a plowman riding thereon or walking in the rear, and can be readily adjusted for use as either cultivator or harrow.

A revolving sulky hay rake has been patented by Mr. Samuel D. Collins, of Galion, O. A standard is pivoted to the rake head carrying catch springs for holding the latter in working position, and a bar with a forked rear end for tripping the rake head, the bar being connected at its forward end to a lever pivoted to the frame.

A potato digger has been patented by Mr. Sylvester W. Kelchner, of Fowlersville, Pa. As the machine is drawn forward, hooked prongs are made to scoop out the potatoes of a hill, discharging them upon grates where they are separated from the soil and passed to elevators, scrapers preceding the prongs, and scraping off the tops of hills, stalks, lumps, and rubbish.

A combined seed planter and fertilizer distributer has been patented by Messrs. Charles F. Zeigler and John D. Autley, of St. Matthew's, S. C. The hopper has a gauge slide with central extension on one end, a transverse lever pivoted about centrally to the extension, and pivoted at one end to a hinged support and at the other end to a rod connecting with a hand lever, in such manner that the discharge can be readily controlled or stopped.

MISCELLANEOUS INVENTIONS.

A wheelbarrow has been patented by Mr. Daniel J. Huckins, of Brooklyn, N. Y. This invention covers a clamp axle bearing for attaching the bodies of metallic wheelbarrows to their tubular iron handles, the bearing consisting of two parts and having bosses with a cylindrical bore to receive the axle journal.

A micrometer gauge for watchmakers has been patented by Mr. Elijah Clark, of Louisville, Ky. This device is calculated to show various measurements in an amplified degree upon a graduated disk, giving exact diameters of pinions, sizes of wires and wheels, and widths of mainsprings, with their tensions.

A cuff holder has been patented by Mr. Emil Smith, of Brooklyn, N. Y. It consists of two spring-operated plates pivoted together to form grasping jaws at one end, one of the plates having a headed stem on its outer face at its grasping end, to hold the cuff on the sleeve button on the wristband.

A book rest and holder has been patented by Mr. Henry F. Hendrix, of St. Louis, Mo. It is made of a piece of wire bent to form a crosspiece and two legs at the rear and two legs at the front, the front parts of the front legs being shaped to hold the leaves of the book.

A piston packing has been patented by Mr. Benjamin C. Waite, of Brooklyn, N. Y. It consists of a split packing ring adapted to be expanded by a spiral spring, a bolt passing through lugs near the ends of the packing ring, arranged so that the diameter of the ring can be reduced thereby as desired.

A box handle for canes or umbrellas has been patented by Mr. Louis Steinberger, of New York city. This invention provides various methods, by means of a screw cap or hinge or other construction, whereby handles may be made convenient receptacles for small articles, such as matches, car tickets, pins, etc.

A baling press has been patented by Mr. Wilson Gardner, of Washington Court House, O. Combined with a box having slots, racks on opposite sides, and a rack below in vertical alignment with the slots, is a follower with hooked arms, pawls, and a lever, the whole making a convenient hand press for baling hay and straw.

A sash fastener has been patented by Mr. Franklin T. Davis, of Mount Vernon, N. Y. It has an upwardly projecting horn and lip on a bed plate attached to the lower sash, and a locking stud attached to the upper sash, in combination with a link or hasp and locking dog pivoted therein, the device acting automatically to lock the sash.

The manufacture of beta-naphthol sulphonic acid has been patented by Mr. Meinhard Hoffman, of Mainkur, near Frankfort-on the-Main, Germany. This is a new color-producing acid, and the invention consists essentially in the preparation and utilization, by a novel method, of a new disulphonic acid of betanaphthol.

A pastry board has been patented by Mr. William T. Black, of Graham, Mo. This invention covers a box with a hinged cover, having on its upper surface cleats or ledges of the same height as the box, united by a handle piece extending lengthwise over the cover, making a combined dough board, mixer, and bread tray.

A clothes washer has been patented by Mr. George W. Crosby, of Good Hope, Ark. This invention covers an improved contrivance of roller beds in a tub, with a roller for working the clothes placed on the beds, making a machine that will also effectually squeeze the water out of the clothes after the clothes are drawn from the tub.

A check hook for harness has been patented by Mr. Franklin T. Davis, of Mount Vernon, N. Y. It is hinged or jointed, and combined with a spring that closes the hook for retaining the check rein, but permits the hook to yield when the horse bears on the check rein or bit, without danger of the horse becoming accidentally unchecked.

A folding soap dish has been patented by Elizabeth Hull, of New York city. It is made to be hinged to plates attached to a bucket or other object, flanges supporting the dish in a horizontal position, while it is formed with a lip having a spring action for clasping the upper edge of the bucket, to hold the dish in a folded or vertical position.

A fire escape has been patented by Mr. Horace F. Neumeyer, of Macungie, Pa. It consists of an endless folding ladder in a casing with a drop door, there being electrically operated devices for releasing the ladder and at the same time giving the alarm on all floors of a building, with clockwork to regulate the movement of the ladder.

An opera chair has been patented by Mr. John M. Sauder, of Harrisburg, Pa. This invention covers a novel construction and mechanism of a chair, to adapt it to be readily folded and extended, so that the joints will work without bending when the seats are arranged in a curved line and the standards are not at right angles with the seat and back.

A school seat and school desk are likewise the subject of two patents issued to the above named inventor. The seat is so made that the seat arms are connected with the end frames, and there are various other novel features, whereby the seats can be readily folded and extended, and will be noiseless when in use. For a desk the end of the seat standard is made with a rounded recess, a curved slot and groove, a spring receiving recess, and the end of the seat arm is made with a rounded projection, making a firm and strong joint.

A baling press has been patented by Messrs. Frank S. Clark and Joseph A. Bachman, of Austin, Texas. It is especially adapted for baling cotton, and its construction is such that the vertical strain is all taken up by screw spindles, and is entirely a tensile strain, that part of the screw under strain decreasing as the operation of pressing proceeds, with various other novel features.

A movable dressing closet for sleeping cars has been patented by Mr. Adoniram J. Chandler, of Cincinnati, Ohio. It consists of a supporting frame carrying curtains, the frame being so arranged that it may readily be attached to or disconnected from the curtain rail of the car, so that the occupants may stand upright in the aisle and dress without being in sight of the other passengers.

A tire shrinker has been patented by Mr. William Lehmer, of Logansport, Ind. Combined with a base is a toothed band, and a sliding block in the base with which one end of the band is connected, there being a pawl or dog for drawing the toothed band taut around the tire, the device being readily adjustable for shrinking tires of different diameters.

A combined hammer and nail feeding device has been patented by Mr. Emmet Horton, of Dundee, N. Y. It combines a receptacle for carrying the nails, with a hammer head, an incline or duct for feeding the nails therefrom automatically by the swinging of the hammer, and a device for clamping or holding each separately delivered nail before setting and driving it.

A wagon jack has been patented by Mr. Daniel S. Wanamaker, of Ramsey's, N. J. The head block is raised and lowered by operating a lever cam, which is so formed that when the head block is fully raised the cam cannot be turned back by downward pressure, the head block also having four rests for the axle, to adapt the jack to be used with wagons having their axles at different heights from the ground.

An ore concentrating jigger has been patented by Mr. John S. Loder, of Leadville, Col. The construction is such that the ore is fed on a screen at the left hand end of the machine, and passes out at the right hand end, valves admitting water at suitable intervals to wash out the fine ore and sand that have passed through the screen, so the jigger can be fed and the ore removed without stopping.

An ant trap has been patented by Mr. William H. Thompson, of Luling, Texas. It consists of a trough embedded in the ground, so that its top is on a level therewith, and is made of tin or other metal bent inward around the top to form a flange, a tube projecting from one end of the trough into a box with a glass cover, into which the ants drop so they cannot escape, and are ordinarily killed by the heat of the sun.

A lock case has been patented by Mr. Henry B. Plumb, of Terryville, Conn. This invention relates to furniture locks adapted for insertion in an undercut mortise and for holding themselves in place without the use of screws or nails, and provides improvements therein to better adapt such cases to variations in the mortises, which may be constructed of the cheapest quality of iron that is rolled into bands or sheets,

An apparatus for making illuminating gas has been patented by Mr. Frederic Egner, of St. Louis, Mo. In combination with a generator are retorts, exhauster, hydraulic seal, and regulating valves, etc., for making a complete apparatus of any desired size, the invention being an improvement on former patented inventions of the same inventor, intended to make 1,000 feet of good permanent gas from about 11¼ pounds Pittsburg slack coal, 1¾ pounds of coke, and 4 gallons of common naphtha, or its equivalent of crude petroleum.

Special.

A RAILROAD PRESIDENT'S VIEWS.

In these busy times, when city people have to go long distances, and are in too much of a hurry to walk, the street railway enterprise has risen to be one of the important interests of modern finance and industry. It requires shrewd and able men to manage it, and it generally rewards them with a prosperous distinction among the business men of the day. One of the most prosperous and best known of the New York street railway men is J. M. Reybert, Esq., who is President of the Houston, West, and Pavonia Ferry line. The man who achieves success in this street railway business does so at considerable outlay of brain and nerve power. Managing such an enterprise may look like easy work, but let those who think it so make trial of it. Mr. Reybert found no beds of roses in his way to prosperity, but by constant and severe attention to business fell into a state of invalidism which threatened to carry him off. He is now, however, restored to health and as busy as ever.

Our New York correspondent visited Mr. Reybert at the office of the company in East Tenth Street, and found him busy superintending the details of the business. Mr. Reybert cheerfully assented to the request that he should tell something about his experience of sickness and recovery.

"It was four or five years ago," said Mr. Reybert, "that I began to run down in health. It was partly owing to too close application to business and partly to the unwholesome atmosphere of the place in which I had to spend most of my time. I was taken with cold in my muscles, which soon assumed the form of rheumatism. I had a great deal of local pain distributed over various parts of my body, and wherever the pain came there came also black spots. Then rheumatism developed into sciatica. My pains were very great. The doctor told my wife that I never could be any better. This was a gloomy outlook for me. I was at my home in Newburgh-on-the-Hudson, trying to make the best of the situation. This was in June, 1884.

"I heard of Compound Oxygen, and sent for a 'Treatment.' Before it reached me I was taken down with rheumatism of the heart, a disease which is as dangerous as it is painful. My breathing was so oppressed that I felt as if with each breath I should choke. When I received the package containing the Compound Oxygen, I felt that I could hardly take its contents. Nevertheless, I tried. At this time my sciatica was very severe, with sudden aches shooting down the nerves of both legs.

"When I tried the Oxygen, I was astonished to find that with a little practice I could inhale it freely. Yet for several days each inhalation would send pain to some old spot. The ache would continue for fifteen or twenty minutes, and then go away. Gradually I was free from these pains, and could inhale the Oxygen without difficulty or unpleasant result.

"Compound Oxygen brought me good sleep. I had previously been in the habit of waking two or three times in the night. Now I was restful. My sleep began to refresh me as it had not done before. I omitted to tell you that with my other disorders I also had dyspepsia. Sometimes this would distress me to such an extent that I did not care for company. It made my appetite poor, and the food I ate did me but little good. The Oxygen repaired my digestive organs, as it did everything else about me. I had also suffered from catarrh so badly that I lost the sense of smell. Well, this Oxygen is a very strange sort of thing, for it drove away the rheumatism and sciatica, it made my digestion so much better that I can now eat like other people, and it entirely cured me of catarrh. Once in a while, if I take cold, I have a little catarrh, but a few inhalations of Oxygen send it away. During all my use of this remedy I have received advice at the Compound Oxygen office, No. 148 Fifth Avenue, and have followed directions in the use of the powders there given me. I have found them of great benefit with the Oxygen and the Oxygenaqua."

"And as to your friends, Mr. Reybert? You have received so much benefit from this remedy that I suppose you have advised others to use it?"

"Yes. I have advised a good many, and I have heard that it has been of great advantage. One case I will mention—that of Mr. Samuel J. Holmes, of this city, a gentleman well advanced in years. He had long been troubled with asthma. He used the Oxygen for seven or eight weeks before it made much impression on him. Then, almost all of a sudden, it began to do its work. It did all we could have expected. It made him breathe freely, naturally, and without pain. He quotes it as a large success, just as I do.

"Yes, sir; you may put me down as a thorough believer in Compound Oxygen. I am not taking it now, except a little occasionally, because I am well and hearty. If I am sick again, give me Compound Oxygen. It is a wonderful restorer."

So say all who give it a fair trial. There are yet a good many people, chronic sufferers and others, who have not tried it. "It is never too late to mend." Write to Drs. STARKEY & PALEN, 1529 Arch Street, Philadelphia, for a valuable little treatise on Compound Oxygen. They will mail it to any address, and it may be of great use to you.

Business and Personal.

The charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

Clockwork wheel and pinions, brass or steel. Plumb & Webb, 289 Wash. St., Newark, N. J.

Capital and inducements wanted to locate a manufactory of Builders' Hardware and Specialties by a mechanical engineer having patents on articles in universal demand. Address T. D. Davis, Williamsport, Pa.

1,000 photographs of New York houses, exteriors and interiors, doorways, vestibules, porches, oriel windows, libraries, parlors, halls, stairways, store fronts, etc., 25 cts. each (8 x 10). Send for circular. Rockwood, 17 Union Square, New York.

Agents Wanted.—New household novelty; sells at sight; profits large. Rogers Novelty Mfg. Co., Cohoes, N. Y.

For Sale.—Rights to manufacture and sell the Metal Tongs illustrated on page 370. Address W. W. Winegar, Chambersburg, Ill.

Geo. E. Lloyd & Co., Electrotype and Stereotype Machinery, Folding Machines, etc. Send for catalogue. Chicago, Ill.

Nickel Plating.—Sole manufacturers cast nickel anodes, pure nickel salts, polishing compositions, etc. $100 "*Little Wonder.*" A perfect Electro Plating Machine. Sole manufacturers of the new Dip Lacquer Kristaline. Complete outfit for plating, etc. Hanson, Van Winkle & Co., Newark, N. J., and 92 and 94 Liberty, St., New York.

Grimshaw.—Steam Engine Catechism. A series of thoroughly Practical Questions and Answers arranged so as to give to a Young Engineer just the information required to fit him for properly running an engine. By Robert Grimshaw. 18mo, cloth, $1.00. For sale by Munn & Co., 361 Broadway, N. Y.

The Knowles Steam Pump Works, 44 Washington St., Boston, and 93 Liberty St., New York, have just issued a new catalogue, in which are many new and improved forms of Pumping Machinery of the single and duplex, steam and power type. This catalogue will be mailed free of charge on application.

Air Compressors, Rock Drills. J. Clayton, 43 Dey st., N. Y.

Haswell's Engineer's Pocket-Book. By Charles H. Haswell, Civil, Marine, and Mechanical Engineer. Giving Tables, Rules, and Formulas pertaining to Mechanics, Mathematics, and Physics, Architecture, Masonry, Steam Vessels, Mills, Limes, Mortars, Cements, etc. 900 pages, leather, pocket-book form, $4.00. For sale by Munn & Co., 361 Broadway, New York.

Shafting, Couplings, Hangers, Pulleys. Edison Shafting Mfg. Co., 86 Goerck St., N. Y. Send for catalogue and prices.

Iron Planer, Lathe, Drill, and other machine tools of modern design. New Haven Mfg. Co., New Haven, Conn.

Wanted.—Patented articles or machinery to manufacture and introduce. Lexington Mfg. Co., Lexington, Ky.

For Power & Economy, Alcott's Turbine, Mt. Holly, N. J.

Machinery for Light Manufacturing on hand and built to order. E. E. Garvin & Co., 139 Center St., N. Y.

Send for Monthly Machinery List
to the George Place Machinery Company,
121 Chambers and 103 Reade Streets, New York.

Presses & Dies. Ferracute Mach. Co., Bridgeton, N. J.

If an invention has not been patented in the United States for more than one year, it may still be patented in Canada. Cost for Canadian patent, $40. Various other foreign patents may also be obtained. For instructions address Munn & Co., SCIENTIFIC AMERICAN patent agency, 361 Broadway, New York.

Supplement Catalogue.—Persons in pursuit of information of any special engineering, mechanical, or scientific subject, can have catalogue of contents of the SCIENTIFIC AMERICAN SUPPLEMENT sent to them free. The SUPPLEMENT contains lengthy articles embracing the whole range of engineering, mechanics, and physical science. Address Munn & Co., Publishers, New York.

Guild & Garrison's Steam Pump Works, Brooklyn, N. Y. Steam Pumping Machinery of every description. Send for catalogue.

Send for descriptive circular on lubrication. Charles H. Besly & Co., North American Agents for Reisert's Celebrated Solid Oil, 175 & 177 Lake St., Chicago, Ill.

Curtis Pressure Regulator and Steam Trap. See p. 350.

Send for catalogue of Scientific Books for sale by Munn & Co., 361 Broadway, N. Y. Free on application.

Iron and Steel Wire, Wire Rope, Wire Rope Tramways. Trenton Iron Company, Trenton, N. J.

Iron and Steel Drop Forgings of every description. Billings & Spencer Co., Hartford, Conn.

Bradley's improved Cushioned Helve Hammer. New design. Sizes, 25 to 500 lb. Bradley & Co., Syracuse, N. Y.

New Portable and Stationary Centering Chucks for rapid centering. Send for price list to Cushman Chuck Co., Hartford, Conn.

Cyclone Steam Flue Cleaners are the best. Crescent Mfg. Co., Cleveland, O.

Curtis Pressure Regulator for Steam Heating Apparatus, Waterworks, etc. Curtis Regulator Works, Boston, Mass.

The Improved Hydraulic Jacks, Punches, and Tube Expanders. R. Dudgeon, 24 Columbia St., New York.

Friction Clutch Pulleys. D. Frisbie & Co., Phila.

Tight and Slack Barrel Machinery a specialty. John Greenwood & Co., Rochester, N. Y. See illus. adv., p. 382.

Keystone Steam Driller for all kinds of artesian wells. Keystone Driller Co., Limited, Box 32, Fallston, Pa.

Magic Lanterns and Stereopticons of all kinds and prices. Views illustrating every subject for public exhibitions, Sunday schools, colleges, and home entertainment. 136 page illustrated catalogue free. McAllister, Manufacturing Optician, 49 Nassau St., New York.

Providence Steam Engine Co., Providence, R. I., are *sole builders* of the "Improved Greene Engine."

Steel name stamps, 15 cts. per letter; steel figures, $1 per set. F. A. Sackmann, 1099 First Ave., Cleveland, O.

Seam and Looping Machines, patent Burr Wheels Brushing Machines. Tubbs & Humphreys, Cohoes, N. Y.

Pattern and Brand Letters, Steel Punch Letters. Vanderburgh, Welis & Co., 110 Fulton St., New York.

Wood Working Machinery. Full line. Williamsport Machine Co., "Limited," 110 W. 3d St., Williamsport, Pa.

Astronomical Telescopes, from 6″ to largest size. Observatory Domes, all sizes. Warner & Swasey, Cleveland, O.

NEW BOOKS AND PUBLICATIONS.

RING-AROUND-A-ROSY. A Dozen Little Girls. By Mary A. Lathbury. New York: R. Worthington.

This holiday book for young people tells the story of a dozen little girls who spend a very merry day together. Verse and picture relate their various adventures, and the funny circumstances which reduce their number, one by one, until but a single little girl is left. Tired and sleepy she goes to bed, and calls them all back again in her dream. It will delight the little people, and will interest the older readers as well, for Miss Lathbury's drawings of child life are quite pleasing, and have frequently sufficient artistic merit to make them worthy of attentive study.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.

Special Written Information on matters of personal rather than general interest, cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Minerals sent for examination should be distinctly marked or labeled.

(1) L. Z. asks: 1. Does a lion belong to the cat or dog family? A. The cat family. 2. Why is it necessary to have the pneumatic gun, described in SCIENTIFIC AMERICAN of October 31, 1885, so long in construction, and was there ever any other projectile tried than the one described in the same issue? A. The gun is required to be of considerable length to realize the full expansive force of the air. We believe there have been some minor changes made in the cartridge carrying the dynamite, but nothing has been used in this gun similar to the buffer-like arrangement used where dynamite has been fired with powder from regular service guns.

(2) J. R. asks if glass is porous? A. According to the usual understanding of the word "porous," glass is not porous.

(3) A. F. H. asks: Is it an essential in a dynamo, substantially after the Siemens pattern, that the armature coil should be wound upon iron? Will not a wood core answer the purpose? A. A current can be generated in an armature without an iron core, but it will be very weak. The iron core seems to be necessary for the production of strong currents.

(4) N. J. asks: 1. What is the temperature kept up in the so-called "flasher" engines (*i. e.*, steam engines without a boiler, where the steam required for each stroke is generated by injecting a small quantity of water into a heated vessel)? If above 350°, how is it that the water does not assume the spheroidal shape? A. The temperature may vary between wide limits. To generate a pressure of 100 pounds to an inch a temperature of 320° Fah. must be maintained. With sufficient heat, the water would assume a spheroidal condition. 2. "Flasher" engines are said to be impracticable, on account of their rapid destruction. In which way does this destruction take place? Is it owing to the rapid succession of high pressure and low pressure in the heated vessel, thus loosening the joints, and tending to tear the vessel, or is it the surface action on the heated brass, where the water spray strikes it? And if so, is the abrasion of the surface of the brass due to the mechanical action or to increased chemical action of the water jet? A. The rapid destruction of such engines is due to the oxidation of the steam generator.

(5) C. E. M. asks for information for making pocket battery for Edison's incandescent light. Explain theory of Holtz electrical machine. A. A battery which will operate a small Edison lamp for a short time, say a half hour or so, may be made by using two elements, each composed of one zinc rod, from ⅜ to ½ inch in diameter, and two carbon rods such as are used in electric lighting. The zinc must be amalgamated. The solution used is that formed of bichromate of potash, sulphuric acid, and water, which has been so often described in the Notes and Queries. For a description of Holtz electric machine consult SUPPLEMENT, Nos. 278, 279, 282, 70, 291, and 321.

(6) F. J. S. writes: I am using a McIntosh galvanic battery, the hard rubber cups of which have become leaky; is there any way of repairing them? A. Stop the leaks with a cement composed of equal parts of gutta percha, brown pitch, and shellac.

(7) A. J. H. writes: 1. I have for some time been using glass lamp chimneys known as "lead glass," also called fireproof; very often they fly to pieces, especially in cold weather; can you explain the reason why? A. It is due to the unequal expansion caused by heating one part of the chimney more than another, or by the exposure of one part of the chimney to a draught of cold air, causing a sudden contraction of that part. 2. Some claim that it is caused by the friction raised by rubbing them when cleaning them with a cloth, while others hold that it comes from the gas generated by the coal oil that accidentally gets inside. A. We think that the answer to your first query is sufficient explanation.

(8) G. F. asks: 1. Can you refer me to back number, or repeat solution to plate brass or copper, in a bath, without electric current? A. You do not say what metal you desire to use in plating the copper. 2. Can you tell me how to make and apply the black japan or paint on woodwork, like trays, handles, pen holders, and the like. A. You will find full instructions for japanning in SUPPLEMENT, No. 316.

(9) J. F. asks (1) for an ink for hand stamps that will not injure the rubber. A. Mix and dissolve 2 to 4 drachms aniline color, 15 ounces alcohol, 15 ounces glycerine. The solution is poured on the cushion and rubbed in with a brush. 2. How to make a varnish or covering for woodwork, such as the black handles on enameled water pails, and the like. A. 1 ounce nutgall broken into small pieces; put into barely ½ pint vinegar, which must be contained in an open vessel, let stand for about ½ hour, add 1 ounce steel filings; the vinegar will then commence effervescing; cover up, but not sufficient to exclude all air. The solution must then stand for about 2½ hours, when it will be ready for use. Apply the solution with a brush or piece of rag to the article, then let it stand until dry; if not black enough, coat it until it is, each time of course letting it remain sufficiently long to dry thoroughly. Afterthe solution is made, keep it in a closely corked bottle.

(10) J. W. W.—The moulds for rubber stamps are made of plaster of Paris. The rubber is pressed into the mould with a small press or clamp, then placed in a small vulcanizing oven heated by steam or a furnace to a temperature from 250° to 275°. We do not know the cost of apparatus.

(11) R. P. M. asks: What is the rule for silvering on glass, such as door knobs and ornaments? I have some glasswork which is hollow, and would like to silver them on the inside only. A. See "How to Silver Glass," contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 105. Take silver nitrate 1 ounce, distilled water 1 pint, strong liquor ammonia sufficient quantity, added very gradually, to first precipitate and then redissolve the silver; then add honey, ¼ ounce. Put sufficient quantity of this solution in the globe, and then place the globe in a saucepan of water; boil it for 10 to 30 minutes, occasionally removing it to see the effect.

(12) D. P. asks the per cent of starch in white and yellow corn, also of potatoes. A. The average quantity is about 53½ per cent in flat yellow American maize and 54¾ in the flat white and round yellow varieties. From 66 to 75 per cent of starch is obtained by the manufacturer from the potato.

(13) M. B. S. B. writes: I have a lot of woolen clothing that has become soiled with linseed oil house paint. Please inform me what will remove it. A. Use turpentine, or benzine, and soap. See table on Removal of Stains and Grease Spots, contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 158.

(14) W. H. D. writes: I spilt tincture of iron on the edge of a book so that all the leaves are stained a little. Is there any way it can be removed without destroying the book? A. The tincture of iron is soluble in a solution of warm oxalic acid, in dilute hydrochloric acid, and in citric acid. These substances will readily remove the iron, but great care must be taken to avoid injuring or destroying the paper of the leaves.

(15) E. McG. asks what the ingredients of "Ayer's Hair Vigor" are. A. According to Professor Chandler's analysis of this preparation, it contains 2·89 grains of lead to the fluid ounce. It is therefore probably a perfumed solution of sugar of lead.

(16) W. F.—All of the cotton factories in this and every other country produce cotton waste. All machine shops and all marine, river, and stationary engines, as well as all factories running machinery, use it.

(17) P. D. L. asks a good recipe for walnut stain for pine wood. A. Make a solution of 3 ounces each permanganate of potash and sulphate of manganese, in 5 quarts hot water. Apply several times with a brush or dip small articles. When the proper tone is obtained, oil or varnish the work.

(18) O. C. P. desires a cure for stammering. A. Reading aloud for several hours daily is often advised, but this fails to prevent stammering in speaking. The latter appears to be a nervous affection, and its abatement depends upon the individual.

(19) R. K. S. asks: Would the inletting of the ocean to the Sahara desert have any influence on the equilibrium of the earth? If not, why? A. Yes. It would change the center of gravity, proportionally, as the relative weight of the water let into the desert would to the whole weight of the earth divided by 2.

(20) H. G.—The piston travels fastest on the first half of its stroke, due to the impulse of the full pressure of the steam. This is not perceptible in engines with heavy flywheels running a large amount of shafting and machinery. It is very perceptible in the motion of the engines of sidewheel steamers.

(21) J. S.—Augers were twisted by hand hot by holding one end in a vise, by the early makers. Now they are made in dies and rollers by machinery, much of which is the subject of patents. The finishing is done with emery wheels and buffs.

(22) W. S. C.—It is generally conceded that a high speed engine requires more lead than a slow speed. There are differences of opinion as to the requirements of the various kinds of engines, and engine builders generally set the lead to suit their own experience.

(23) T. S. W.—Pure, sweet, cold pressed lard oil mixed with ten per cent of Pratt's astral oil makes a good oil for lanterns. We cannot give the mixture sold by the dealers, as every one mixes to suit his trade.

(24) J. S. asks: 1. What amount of horse power would be required to force from the bottom of a well 30 feet deep 200 gallons of water in a minute, and what size pump and pipe would be required? A. Two horse power, including friction of pump. Pump should have 7 inch by 12 inch cylinder, and be worked 100 times a minute for 200 gallons. 2. If a vessel containing 50 gallons of air was placed at a depth of 30 feet under water, what amount of pound weight would it raise to the surface, how long would it be in making the ascent, and what amount of horse power would it produce? A. Fifty gallons of air will lift about 425 pounds in water. If placed at a depth of 30 feet, it must not be subject to compression for the above duty. If placed in an elastic inclosure, it will not lift more than 212 pounds at that depth, but will increase its lifting power by expansion as it rises. The time required to come to the surface might be 5 or more seconds according to the work required, and might produce 1½ horse power.

(25) J. A. H. writes: In replies to correspondents, October 3, 1885, is a recipe for aerated bread. 1. Are the directions there complete for making this bread? A. Yes. 2. How much water should be used to the soda and acid? A. Sufficient to make a dough. 3. Should any salt be used? A. No. Carbonate of magnesia and the muriatic acid combine and form salt. 4. Will the muriatic acid found at the stores do to use? A. It is best to buy the article from the druggist.

(26) H. and M. have an argument about potassium. M claims it is a mineral, H says it is a metal. Which is right? A. H is right. Potassium is a metal, possessing curious qualities. It bursts into flame when it touches water. It is silvery in appearance, but quite soft—softer than lead, and much lighter in weight than the latter. Potassium, although in itself soft, is a constituent of certain minerals found in one of the hardest rocks, namely, granite.

(27) S. T. writes: In SCIENTIFIC AMERICAN of October 17, you state that a sailboat would not move forward if the wind from a bellows on board were directed against her sail. This of course is correct if the bellows were parallel and the sail at right angles with the boat; but supposing the bellows were placed at right angles with a catboat, and directed against a sail held 30 or 35 degrees from the boat, as in sailing across the wind, would not there be a perceptible motion forward on still water? A. The principle of an artificial blast athwartship impinging upon an inclined surface or sail, and thereby imparting motion to the boat, is correct; but the mechanical effort produced in proportion to the power consumed is so small that any practical allusion to such projects savors of the ridiculous. The bellows will do more work if pointed astern and blown against the air or water.

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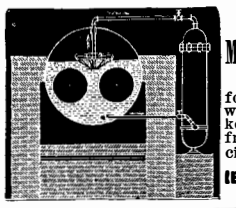

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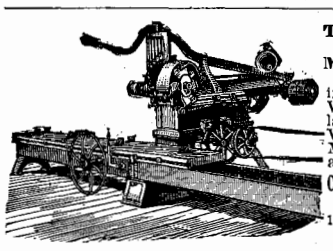

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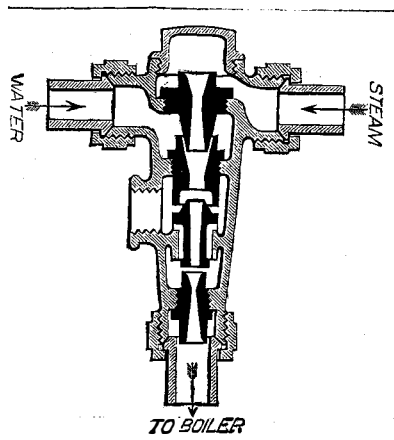

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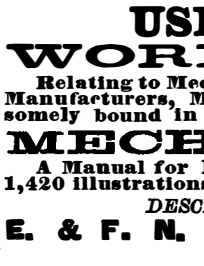

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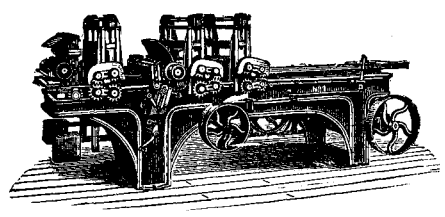

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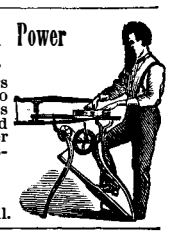

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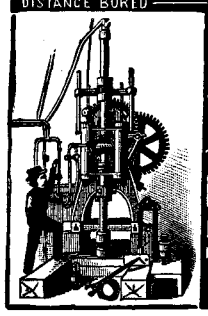

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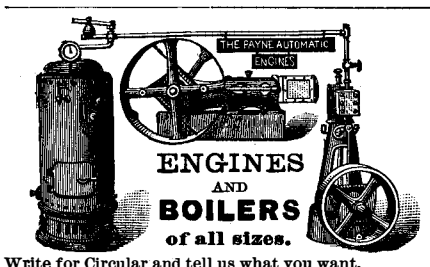

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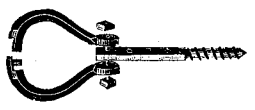

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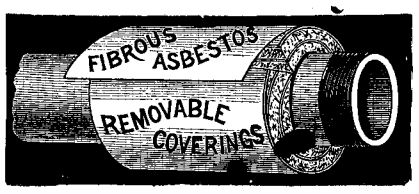

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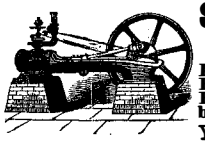
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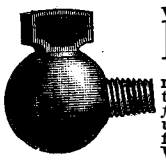
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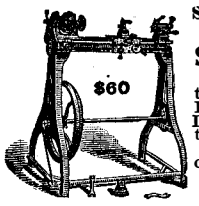

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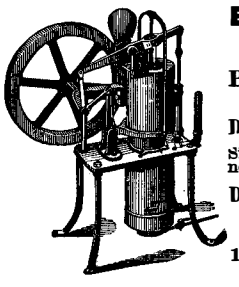
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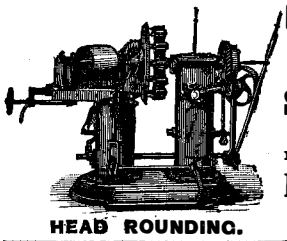
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